Appendix H
USACE Hydrology Report:
Chatfield Dam and Reservoir

US Army Corps
of Engineers ®
Omaha District

CHATFIELD DAM AND RESERVOIR
DENVER, COLORADO

FINAL REPORT

Feasibility Study
December 2006 (updated December 2008)

CHATFIELD DAM AND RESERVOIR REALLOCATION STUDY

List of Figures

List of Tables

INTRODUCTION

Study Purpose

Due to the growing demands for municipal water supplies in the Denver Metro area, in 1997, the Colorado Water Conservation Board requested the U.S. Army Corps of Engineers (Corps) undertake a study of Chatfield Reservoir to reallocate a portion of the flood control storage for municipal water supply. The Tri-Lakes feasibility study was initiated in 1998 to evaluate the impacts of reallocating up to 20,600 acre-feet of flood control storage for water supply purposes. The purpose of this feasibility study is to investigate the potential impacts the reallocation would have on flood control regulation, recreation, and fish and wildlife both, upstream and downstream of the reservoir.

Study Scope

A scope of work was developed for the hydrologic analysis of the reallocation of storage from flood control to multi-purpose use for Chatfield Dam. Numerous objectives were established which examined and addressed, 1) setting up and calibrating a model to simulate the Corps' three flood control reservoirs located in the Denver area for a historical period of record, 2) Adjust historic streamflows to account for current urbanization through the study reach, and 3) develop flow and elevation duration and probability relationships for both, the Corps reservoirs and for the South Platte River downstream of the reservoirs for with and without project conditions.

Study Area

The study area encompasses the Denver, Colorado and vicinity, which is located in the north central portion of the state. The area includes the South Platte River from Chatfield Reservoir downstream to Julesburg, Colorado and includes Chatfield, Bear Creek, and Cherry Creek Reservoirs. A map of the area is shown on Figure 1.

Basin Description

The South Platte River basin originates along the eastern slope of the Continental Divide and flows in a southeasterly direction into Eleven Mile Canyon Reservoir. From there, the river changes direction, flows northeast to Cheesman Reservoir and then on to Chatfield Reservoir. The flow of the South Platte River at the Chatfield site is affected by transmountain diversions (which import water to the basin from the western slopes of the Rocky Mountains), storage reservoirs, power developments, diversions for irrigation and municipal use, and return flow from irrigated areas.

The drainage area above Chatfield Reservoir encompasses an area of 3,018 square miles. The topography of the basin varies greatly; ranging from mountainous

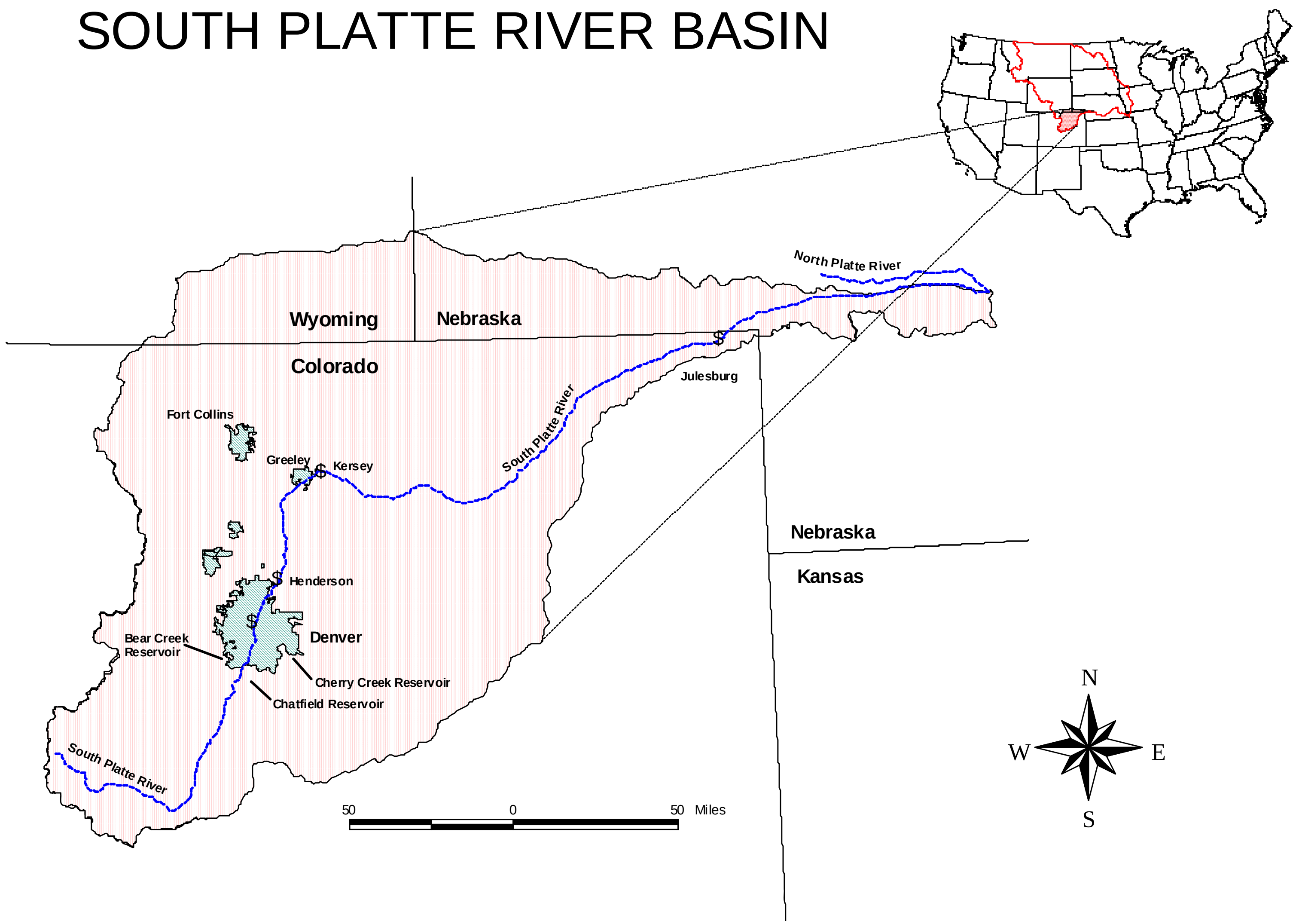


Figure 1 – Location Map – South Platte River Basin

terrain with peak elevations exceeding 14,000 feet above mean sea level (ft msl) on the Continental Divide to rolling foothills and high plains with elevations near 5,400 ft msl at Chatfield Dam.

Downstream of Chatfield Dam, the South Platte River continues to travel to the northeast to where the river confluences with the North Platte River near North Platte, Nebraska to form the Platte River. The channel capacity varies between Denver and Henderson. The river channel below Chatfield Dam and above the Bear Creek confluence can safely pass 5,000 cubic feet per second (cfs). Through Denver, the channel capacity is approximately 10,000 cfs. However, channel capacity further downstream near Henderson, Colorado varies between 3,000 and 5,000 cfs.

Annual precipitation ranges from 30 inches near the Continental Divide to less than 15 inches on the plains. Most of the precipitation in the mountains occurs as snow, which typically falls between October and March. On the plains, precipitation falls mainly between April and September. A major portion of the annual inflow into Chatfield Reservoir results from the mountain snowmelt. Flooding in the Denver area is usually the result of intense thunderstorm rainfall or from snowmelt augmented by rainfall.

Three major flood control reservoirs are located on the South Platte River or its tributaries; Chatfield Dam, Bear Creek Dam, and Cherry Creek Dam. These three reservoirs control flooding through the Denver area along the South Platte River. All three projects are federally owned facilities, with project operation and maintenance functions the responsibility of the Tri-Lakes Project Manager under the direction of Operations Division, Omaha District, Northwestern Division, U.S. Army Corps of Engineers. They operate for the benefit of flood control, recreation, and fish and wildlife purposes. A summary of reservoir data for all three reservoirs is listed in Table 1.

Chatfield Dam and Reservoir is located on the South Platte River immediately downstream of the confluence of the South Platte River and Plum Creek, about 8 miles upstream of Denver, Colorado. The Chatfield Project was authorized by the Flood Control Act of 1950. Construction on the project was initiated in 1967, closure of the dam was made in late summer 1973, the outlet works completed in 1974, and the spillway construction was completed in April 1975. Chatfield Dam is a multi-purpose project consisting of an earthfill embankment, emergency spillway, outlet works and a multi-purpose reservoir. At the top of conservation pool (5432 ft msl) Chatfield Reservoir extends 2.5 miles upstream, has a surface area of 1,423 acres, less than 10 miles of shoreline and a maximum depth of 55 feet. The Denver Water Board, through the Colorado Water Conservation Board, owns 11,000 acre-feet of storage in Chatfield Reservoir.

Cherry Creek Dam and Reservoir is located on Cherry Creek just southeast of the City of Denver, Colorado, in Arapahoe County, 11.4 miles above the confluence with the South Platte River. The Cherry Creek Project was authorized by the Flood Control Act of 1941 and 1944. Construction on the project was initiated in July 1946, closure of the dam was made in October 1948, the outlet works completed in 1949 and the embankment and spillway construction were completed in January 1950. Cherry Creek Dam is a multi-purpose project consisting of an earthfill embankment, emergency spillway, outlet works and a multi-purpose reservoir. At the top of conservation pool (5550 ft msl) Cherry Creek Reservoir extends 1.5 miles upstream, has a surface area of 844 acres, less than 7 miles of shoreline and a maximum depth of 46 feet. Currently there is no water supply storage allocation in Cherry Creek Reservoir.

Corps of Engineers design guidance for dams located above populated areas states they should safely pass a Probable Maximum Flood (PMF) without overtopping the embankment. The most recent precipitation estimates prepared by the National Weather Service for this area indicate that Cherry Creek Reservoir could safely pass no more than 75% of the PMF under existing development with adequate freeboard. A dam safety evaluation study to determine optimal solutions to the hydrologic inadequacy of Cherry Creek Reservoir is underway, with current studies focused on development of the Probable Maximum Precipitation (PMP). A new development relative to Cherry Creek Dam is that all Corps dams are being screened and assigned a safety classification rating. This Dam Safety Action Classification (DSAC) system classifies dams into five classes with class I having the highest priority for attention and class V the lowest priority. Using the new criteria, Cherry Creek Dam has received a DSAC II rating because of the amount of development below the dam and the PMF studies that have identified a potential for an extreme precipitation event that could fill the reservoir and possibly overtop the dam. Part of the screening process for Corps dams with a DSAC rating of I, II or III is to identify interim measures to reduce safety risks while long-term solutions are being pursued. These measures could be structural or non-structural. Some of the measures being implemented for Cherry Creek Dam are an improved flood warning system, updating response procedures with emergency managers, evaluating the capacities of the downstream channel and emergency spillway, as well as evaluating the vulnerability to seepage and earthquakes. The reservoir data on Cherry Creek Dam in Table 1 reflects original design conditions and will change with the completion of the Dam Safety Assurance Study.

Table 1
Summary of Reservoir Data

Zone	Top of Zone Elevation (ft msl)	Surface Area (acres)	Gross Storage (acre-feet)	Incremental Storage (acre-feet)
Chatfield Dam				
Top of Dam	5527.0	-------	-------	-------
Maximum Surcharge - Spillway Design Flood	5521.6	5,990	350,700	116,500
Flood Control Pool - Spillway Crest	5500.0	4,780	234,200	206,800
Multipurpose Pool	5432.0	1,430	27,400	7,800

Table 1
Summary of Reservoir Data

Zone	Top of Zone Elevation (ft msl)	Surface Area (acres)	Gross Storage (acre-feet)	Incremental Storage (acre-feet)
Sediment	5426.0	1,180	19,600	19,600
Inactive	5385.0	12	23	23
Bear Creek Dam				
Top of Dam	5689.5	-------	-------	-------
Maximum Surcharge - Spillway Design Flood	5684.5	1,220	78,000	47,300
Flood Control Pool	5635.5	715	30,700	28,700
Multipurpose Pool	5558.0	107	1,970	1,905
Inactive	5528.0	16	65	65
Cherry Creek Dam				
Top of Dam	5644.5	-------	-------	-------
Maximum Surcharge - Spillway Design Flood	5636.2	4,540	226,600	134,500
Flood Control Pool - Spillway Crest	5598.0	2,640	92,100	79,300
Multipurpose Pool	5550.0	850	12,800	12,800

Bear Creek Dam and Reservoir is located west of Denver on Bear Creek, approximately 8.0 miles upstream of the confluence with the South Platte River. The Bear Creek Project was authorized by the Flood Control Act of 1968. Construction on the project was initiated in October 1973, closure of the dam was made in July 1977, the outlet works completed in 1977, and the embankment and spillway construction were completed in July 1979. Bear Creek Dam is a multi-purpose project consisting of an earthfill embankment, emergency spillway, outlet works and a multi-purpose reservoir. At the top of conservation pool (5558 ft msl) Bear Creek Reservoir extends 0.5 miles upstream, has a surface area of 110 acres, and about 2.2 miles of shoreline. Currently there is no water supply storage allocation in Bear Creek Reservoir.

Reservoir Operations

The normal regulation of the Chatfield, Bear Creek and Cherry Creek Reservoirs involves the Corps of Engineers and the State of Colorado. During flooding periods, operation of the reservoirs is the responsibility of the Corps working in conjunction with state and local authorities. During non-flood periods, the Colorado State Engineers Office keeps track of water rights calls on the South Platte River and makes requests for gate operation at the three reservoirs directly to the Tri-Lakes Project Office.

For flood control operations, Chatfield Reservoir is part of a parallel reservoir system with Bear Creek and Cherry Creek Reservoirs. During flood inflow periods and/or rising pool levels Chatfield, Cherry Creek and Bear Creek Reservoirs will be independently regulated to assure safe control of each flood event. System or coordinated regulation of the three projects in parallel will be necessary only after flood flows have entered the reservoirs and during flood storage evacuation. Evacuation of flood control storage from Chatfield as an individual project will only occur when no flood storage is occupied in Bear Creek or Cherry Creek Reservoirs. When water has accumulated in the flood storage zones of the three reservoirs, an equal protective balance of available flood storage will be maintained during the pool evacuation of these projects. Current reservoir regulation criteria (rule curves) and target flows downstream on the South Platte River used for regulating flood storage evacuation are taken from the Water Control Manuals for the three reservoirs and are listed in Table 7.

DATA ACQUISITION

For this study, considerable historical and geospatial data were required to conduct the analyses. Before the analyses began, all relevant sources of data were explored. The types of data that needed to be collected for this study included streamflow data, meteorological data, and topographic data.

Hydrologic Data

Discharge information was required for hydrologic model development, calibration, and verification, and for performing statistical analyses. The hydrologic data were obtained from the USGS Water Resources Data Reports and Corps' 0168 Daily Bulletins for reservoirs. Data on the Corps and USGS streamflow gages, their locations, gage identification numbers, periods of record, and other pertinent information are shown in Table 2.

Table 2
South Platte River Basin Gaging Station Data

Stream and Location	Station ID	Gage Type	Contributing Drainage Area (sq mi)	Period of Record
South Platte River at Littleton, CO	06710000	Flow	3,069	1942-86
Cherry Creek nr Denver, CO	06713500	Flow	409	1942-current
Cherry Creek nr Melvin, CO	06712500	Flow	360	1939-84
Bear Creek at Morrison, CO	06710500	Flow	164	1919- current
Chatfield Dam Lake	COE[1]	Stage	3,018	1975- current
Bear Creek Reservoir	COE	Stage	176	1977- current
Cherry Creek Reservoir	COE	Stage	385	1957- current
South Platte River at Denver, CO	06714000	Flow	3,861	1895- current
South Platte River at Henderson, CO	06720500	Flow	4,713	1926- current

Table 2
South Platte River Basin Gaging Station Data

Stream and Location	Station ID	Gage Type	Contributing Drainage Area (sq mi)	Period of Record
South Platte River at Kersey, CO	06754000	Flow	9,598	1901- current
South Platte River at Julesburg, CO	06764000	Flow	23,193	1902- current

[1] COE – Corps of Engineers

Meteorological Data

Meteorological records were needed for modeling. Monthly precipitation and evaporation were obtained from the Corps and the National Oceanic and Atmospheric Administration (NOAA) Climatological Data for nearby gages and are listed in Table 3.

Table 3
Climatological Data Station Data

Gage and Location	NOAA Index Number	County	Gage Type	Period of Record
Cherry Creek Reservoir	COE[1]	Arapahoe	Evaporation	1959-99
Stapleton Airport	8932	Denver	Precipitation	1948-02

[1] COE – Corps of Engineers

Other Data.

Other sources of relevant data were also used for this study. Corps of Engineers reports included, Chatfield Dam Water Control Manual (COE,1971), Bear Creek Dam Water Control Manual (COE,1977), and Cherry Creek Dam Water Control Manual (COE,1971).

HYDROLOGICAL ANALYSIS

The hydrologic analysis will be used in determining the impacts to flood control, recreation, wildlife and fisheries within the reservoir, and the impacts on downstream wildlife and fisheries, and property due to a potential permanent increase in the conservation pool for Chatfield Dam. Major tasks involved for the study include: 1) Modeling of the Tri-Lakes Reservoir System over a historic period of record. 2) Developing a historic period of record of streamflow data for the modeling. 3) Adjusting the streamflows for current level of development in the basin, 4) Establishing baseline conditions for determination of impacts on potential conservation pool raises on Chatfield Reservoir and 5) Developing flow and lake elevation duration and probability relationships for various locations throughout the study area.

Streamflow Data.

Historic streamflow records were compiled and imported into the Hydrologic Engineering Center's (HEC) data storage system HEC-DSS (HEC,1995). The database included historic: daily streamflow records, reservoir inflows, reservoir outflows, and reservoir pool elevations. The period of record used for the analysis was 1942 through 2000.

Historic Reservoir Inflows.

Since actual reservoir inflows were not available for the entire analysis period, inflow data were obtained from multiple sources. Nearby USGS gaged daily streamflow data were used for the periods when reservoir inflows were not available. After completion of the reservoirs, inflow data were calculated from daily pool elevations using the Corps' 0168 Daily Bulletins. Table 4 lists the data sources used for the reservoir inflows and when they were applied to the analysis period of record. For the South Platte River downstream of the reservoirs, daily flow records were available for the Denver, Henderson, Kersey, and Julesburg gages for the entire analysis period of record 1942 through 2000.

Table 4
Streamflow Data Used in HEC-5 Model

Gage and Location	Streamgage Used	Period of Record Used
Chatfield Reservoir	South Platte River nr Littleton, CO	Jan 1, 1942 – May 31, 1975
	Chatfield Reservoir 0168's	Jun 1, 1975 – Dec 31, 2000
Bear Creek Reservoir	Bear Creek at Morrison, CO	Jan 1, 1942 – Jul 18, 1977
	Bear Creek Reservoir 0168's	Jul 19, 1977 – Dec 31, 2000
Cherry Creek Reservoir	Cherry Creek nr Melvin, CO	Jan 1, 1942 – Aug 10, 1942
	Cherry Creek nr Denver, CO	Aug 11, 1942 – May 14, 1957
	Cherry Creek Reservoir 0168's	May 15, 1957 – Dec 31, 2000

[1] Note: 0168 inflows calculated from daily pool elevations

Local Inflows

Local or incremental inflows to the South Platte River were determined by routing the historic reservoir releases from the reservoirs to downstream USGS gage locations, then subtracting out the routed flows from the USGS observed flows. For the period prior to the reservoir being in operation, the flow at the reservoir site was routed to the downstream gage and subtracted to compute the local flows. The modified puls routing method was used to route daily flows for six reaches; 1) Chatfield Dam to Bear Creek, 2) Bear Creek Dam to the confluence with the South Platte River, 3) Cherry Creek Dam to the confluence with the South Platte River, 4) South Platte River from the Denver gage to the Henderson gage, 5) South Platte River from the Henderson gage to the Kersey gage, 6) South Platte River from the Kersey gage to the Julesburg gage.

Local or incremental flows for the South Platte River were derived for 4 reaches:

1) Chatfield reservoir to the South Platte at Denver gage.
2) Denver gage to the Henderson gage
3) Henderson gage to Kersey gage
4) Kersey gage to Julesburg gage

Local flows from just downstream of Bear Creek and Cherry Creek dams to their confluence with the South Platte River were assumed to be reflected in the local flows derived for the South Platte. In addition, it was assumed that historical diversions are reflected in the local flows and would remain constant with different operations of Chatfield, Bear Creek, and Cherry Creek Reservoirs. The flows were imported into the HEC-DSS.

Inflows Adjusted to Current Level of Development.

To maintain a consistent hydrologic response to meteorological conditions, the incremental local inflows for the entire period-of-record were adjusted to the year 2000 level of development to reflect current urbanization in the basin. A trend analysis was performed which included the evaluation of historical streamflow records on the South Platte and tributaries as well as precipitation records in the Denver area. Adjustment factors derived from the trend analysis were then applied to historical daily streamflow values.

The trend analysis for historical daily inflows to the three reservoirs was examined and no corresponding increase in runoff over time was observed. Therefore, the daily flows were not altered for reservoir inflows. The local flows downstream of the reservoirs did reflect an increasing trend in flows throughout the study period, as would be expected as a reach undergoes urbanization during the study period. Figure 2 show the local flows at the Denver gage with the increased runoff over time. A trend analysis was performed on the incremental local inflows. A linear regression curve was derived using the annual runoff volumes for each of the local inflows at the USGS streamflow gage locations on the South Platte River. The annual volumes were then adjusted to year 2000 level of development by subtracting the regression curve value for a particular year from that same year's actual runoff and then added to the regression curve value for the year 2000. The adjusted value was then divided by the historic value to derive a ratio to apply to each of the daily values for that year. A table listing the historic values, adjusted values and the ratio applied to each year for the local inflows downstream on the South Platte River are located in Appendix H-A.

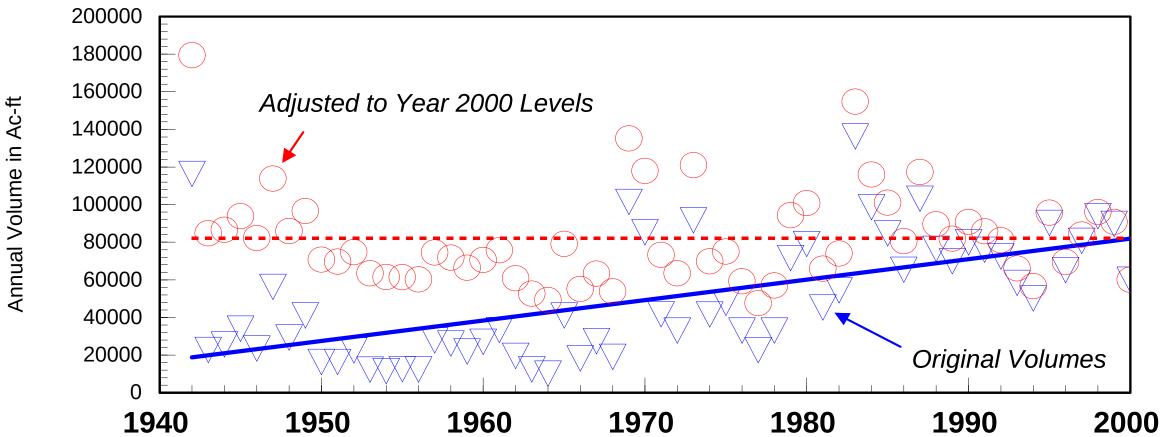


Figure 2 – South Platte River at Denver gage trend analysis

Conversion of Annual Maximum Daily Flows to Instantaneous Peak Flows.

For developing flow probability relationships on the South Platte River at the Denver, Henderson, Kersey, and Julesburg locations, the largest annual daily flow values derived from the HEC-5 model results need to be converted to an instantaneous peak flow. This was accomplished with a trend analysis by taking the observed period of record flow data for each location and plotting the annual instantaneous peak flow to the daily mean flow that occurred on that same day as shown in Figure 3 for the Henderson gage. A linear regression equation was derived for the Henderson and Kersey gages. For Julesburg, a ratio of the observed peak flow to the observed mean daily flow was averaged over the period of record and applied to each of the largest annual daily flow values from the HEC-5 model. Only the period of record after Chatfield Reservoir was built was used, which was 26 years. The regression equation was then applied to the annual peak daily flow that occurred from the HEC-5 modeling results for each location. The formula used is listed below and the regression parameters are listed in Table 5

$Y_{max} = mx + b$ where,

Y_{max} = Annual maximum instantaneous peak discharge
m = Annual maximum daily flow
x = Factor
b = Constant

The linear regression did not give satisfactory results for the Denver gage. Therefore, a multiple linear regression analysis was performed resulting in a better fit to the data. HEC's Multiple Linear Regression Program (MLRP) (HEC,1970) was utilized and the following regression equation developed.

$Y_{DenMax} = 10^{\wedge(0.604*\log10(m)+(1.91))}$ where,

Y_{DenMax}= Annual maximum instantaneous peak discharge for Denver
m= Annual maximum daily flow

Table 5
Factors to convert mean daily to peak discharges

Gage Location	Factor (x)	Constant (b)	R^2
Denver	-----	------	
Henderson	1.535	2988	0.70
Kersey	0.929	2414	0.89
Julesburg	1.060	0	-----

For reservoir outflows, the annual peak daily flow was not converted to an instantaneous peak flow since reservoir operations are normally made on a daily basis with the outflow from the reservoir set once a day. Since the outflow would not likely change during the course of the day under most conditions, the daily flow and instantaneous peak values would be the same.

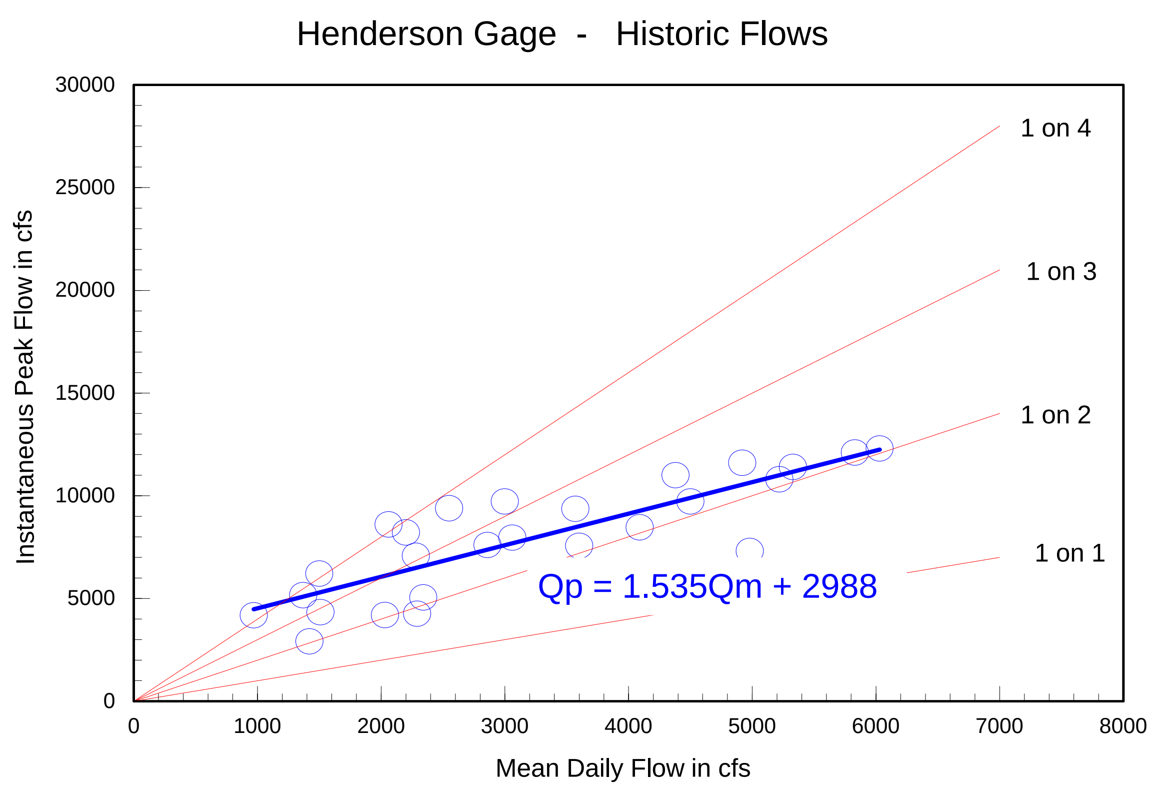


Figure 3 - Relationship between Mean Daily Flow and Instantaneous Peak Flow

Model of TriLakes Reservoir System.

To simulate the operation of Chatfield, Bear Creek and Cherry Creek Reservoirs, an HEC-5 (HEC,1986) model was setup. HEC-5 was developed by the Corp's Hydrologic Engineering Center (HEC) and is designed to assist in planning studies for evaluating flood control and conservation storage requirements for each project in a system of reservoirs. It can also be used to evaluate the effects of changes in operational criteria on downstream flows and on other reservoirs within the system. Reservoir simulation is accomplished by simulating the sequential operation of a system of reservoirs of any configuration using synthetic floods or historical streamflow records.

Demands can be minimum channel flows, diversion requirements, and energy requirements. Demands can be specified at the reservoir and at downstream locations (called Control Points). Physical reservoir constraints define the available storage for flood control and conservation purposes and maximum outlet capability for a multiple reservoir system. Operational constraints can include maximum non-damaging flows and reservoir release rate-of-change. The simulation process determines the reservoir release at each time step and the resulting downstream flows.

The model was configured with Chatfield, Bear Creek, and Cherry Creek Reservoirs as upstream boundaries. Control points downstream of the reservoirs for the flood control operation targets were established on the South Platte River at the Denver, Henderson, Kersey, and Julesburg streamflow gages. Physical data for each of the reservoirs were taken from the Water Control Manuals and configured with the elevation-area-capacity relationships. A combined discharge rating curve was developed for the outlet works and the spillway. Historical inflow data for the three (3) reservoirs are included along with incremental flow between the control points on the South Platte River. Rules curves were based on the Water Control manuals for the three dams. Elevation-area-capacity relationships and outlet rating curve relationships are shown in Appendix H-B.

The routing of flows through the various reaches were accomplished using the modified puls method. The storage outflow relationships were furnished by the Hydraulics Section and were developed using the HEC-2 (HEC,1995) backwater model for the South Platte River and tributaries. Storage outflow relationships were derived for the following reaches and are shown in Appendix H-B.

1. Chatfield Dam to Bear Creek
2. Bear Creek Dam to confluence with the South Platte
3. Bear Creek confluence to Denver gage
4. Cherry Creek Dam to confluence with the South Platte
5. Denver gage to Henderson gage
6. Henderson gage to Kersey gage
7. Kersey gage to Julesburg gage

The HEC-5 model was configured with historical daily flow data from January 1, 1942 through December 31, 2000. Evaporation data for each reservoir was based on the average monthly values for Cherry Creek Dam for its period of record 1959 through 1999. Average monthly rainfall values for the Denver Stapleton Airport precipitation gage for the period of record from 1948 to 2002 were subtracted from the monthly evaporation values and applied to all three dams. Monthly evaporation data, rainfall data and the final values used in the model are shown in Table 6.

The model was utilized with a forecast look-ahead period of 24 hours assuming perfect foreknowledge of downstream flow conditions at the Denver control point and reservoir inflows. This allows the cutting back on outflows from the reservoir when downstream runoff is forecasted to exceed various thresholds.

Table 6
Average Monthly Evaporation, Rainfall and Net Evaporation (inches)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pan Evaporation	0.75	0.92	1.67	3.87	6.54	8.40	9.46	8.30	6.53	4.44	2.49	0.98
Lake Evaporation[1]	0.53	0.64	1.17	2.71	4.58	5.88	6.62	5.81	4.57	3.11	1.74	0.69
Precipitation	0.52	0.59	1.24	1.77	2.48	1.67	2.04	1.58	1.17	0.97	0.86	0.55
Net Evaporation[2]	0.00	0.05	-0.07	0.93	2.10	4.21	4.58	4.23	3.40	2.13	0.89	0.14

Note: [1]Lake Evaporation = Pan Evaporation*Pan Coefficient. Pan Coefficient = 0.70
[2]Net Evaporation = Evaporation– Precipitation. Used in HEC-5 model.

Historic Chatfield Releases

With the development of the HEC-5 model, it was necessary to estimate historic water supply data for release from Chatfield Reservoir. No historic water supply values were available from the local sponsor. However, there were daily reservoir release records available for Chatfield Reservoir since its construction (1976 through 2000), but these records did not differentiate between flood flow releases and historic water right releases. To account for this, historic Chatfield daily releases were compared to the daily pool elevation. If the pool was below 5432.0 ft msl and there was a release that day, then it was considered a water right release. If the pool was above 5432.0 ft msl and there was a release that day, then it was considered to be a flood control release and the water supply release was set to 0 cfs.

Since no Chatfield releases were available prior to construction of the dam, there was no way to determine what the day to day water right flows would be from the historic streamflow records on the South Platte. Water rights flows for years prior to Chatfield Dam construction were estimated based on water rights flows in years after dam construction. The average annual inflow was calculated for each year of the period of record 1942 through 2000. Water rights flows for years prior to the beginning of project operation were assumed to be similar to water rights flows in years with similar annual average flows after project operation began. For example, the average daily flow in 1943 was 133.3 cfs prior to construction of Chatfield Reservoir. This compared to an average daily flow of 139.2 cfs for 1989, after the construction of the dam. Therefore, calculated water right releases for 1989 were initially applied to 1943. Daily water right flows were then corrected by comparing the historic daily inflow for the pre-dam construction year to the daily water right flow for the year chosen to represent it. If the inflow value to the reservoir was at least 50 percent of the water right flow for that day, then the original water right value was used. If the inflow to the reservoir was less than 50 percent of the water right flow, then the original water right flow was reduced to twice the inflow value. Since this method lowers the overall average annual water supply values, daily flows were factored each year by the percent difference between the adjusted average annual water supply value and original average annual value taken from after the construction of the dam. Average yearly inflows, years selected for water right values, and average yearly water right flows are listed in Table H-A5 of Appendix H-A.

While the water supply estimates may not be accurate and not necessarily an indication of how water may be allocated in the future, the HEC-5 model will be able to show the relative differences when comparing the base condition for the existing multipurpose pool and the with project conditions and their potential impacts.

Model Calibration

Once the HEC-5 model was configured, it was calibrated and verified using the historical period of record of Chatfield Reservoir data from 1976 to 2000. A 24-hour time step was used. Local inflows used did not include the adjustment to the year 2000 development. Parameters adjusted to calibrate and verify the model included, the maximum daily incremental increase in releases from the reservoirs, the total daily maximum outflows from the reservoirs, and the maximum target flows at the downstream control points of Denver and Henderson. Comparisons of the observed and modeled daily pool elevations for Chatfield Reservoir and daily flows for the Denver gage are shown in Figures 4 and 5 for the 1983 high flow event, and Figures 6 and 7 for the 1995 high

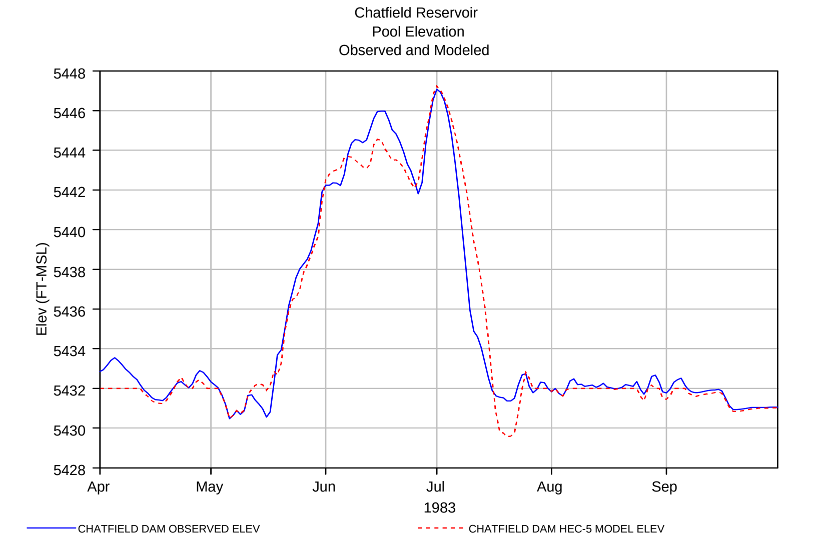


Figure 4 – Chatfield pool elevations for 1983 event.

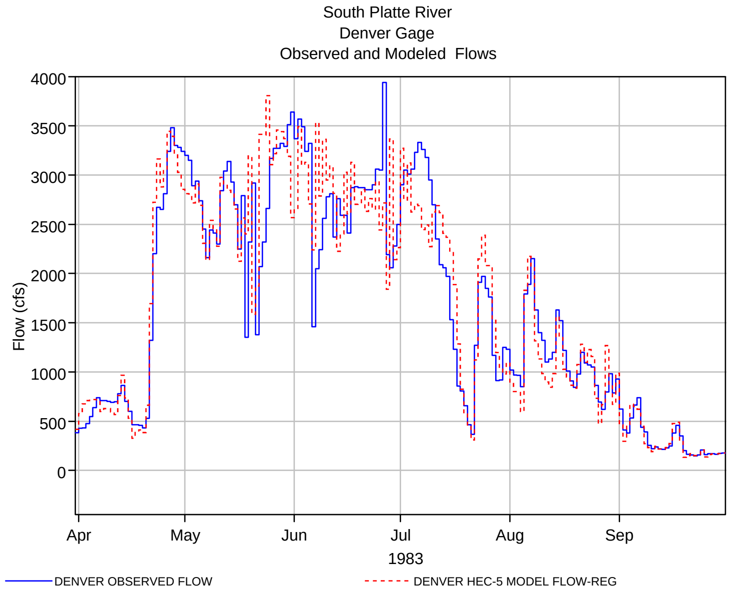


Figure 5 – South Platte flows at Denver for 1983 event.

flow event.

Over the period of record used for calibration, when Chatfield Reservoir is at or near the top of the conservation pool 5432 ft msl (which is the majority of the time), the model does a good job of replicating the pool elevations which are usually within a foot of the observed data. During high inflow years, the model did a good job of matching the peak pool elevation during the 1983 and 1995 flood events. To get the two high flow years to match the observed data, the maximum allowable outflow from Chatfield Reservoir and the maximum allowable flow at the control points at Denver and Henderson were adjusted and were not the same for each high flow event. This was seen in the observed data where the maximum reservoir outflows were below 2,900 cfs in 1983 and 3,400 cfs in 1995. Also, it appears that maximum target flows applied not only to Denver, but to Henderson, which is not a target flow location listed in the Water Control Manual. While the reservoir outflows and downstream target flows were not consistent for both high flow events, they were all below the allowable maximum flow values found in the Water Control Manual. This shows the constraints of the HEC-5 model in that the rule curves may not be followed by the dam operator in the same manner as the model. In fact, different operators would not likely make the same decisions for the same event. For instance, the model assumes perfect knowledge of potential runoff 24 hours ahead of time at the Denver or Henderson control points and makes a release decision based on that information.

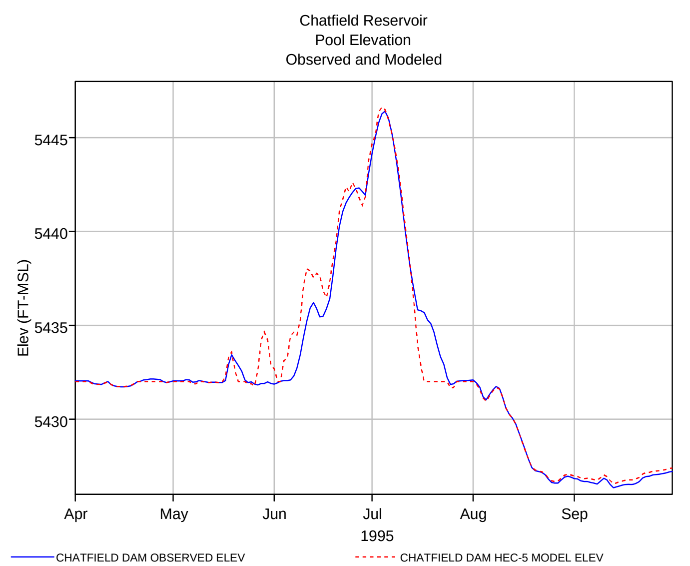


Figure 6 - Chatfield pool elevations for 1995 event.

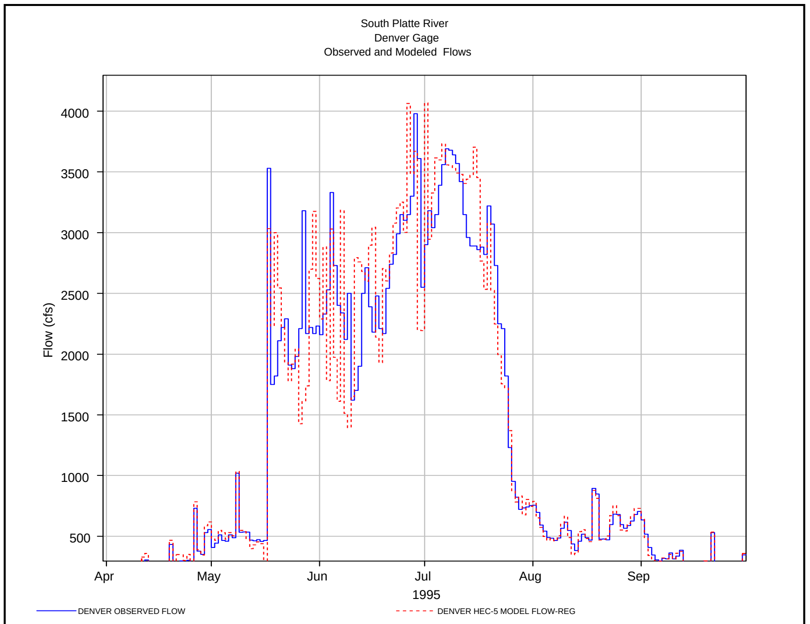


Figure 7 – South Platte flows at Denver for 1995 event.

Actual project operations are based on a number of factors including reservoir inflow, downstream flow, and weather and flow forecasts. The regulator does not have perfect knowledge of these factors into the future. Therefore, the actual operation of the reservoir will diverge from what the HEC-5 model performs. Since the prior day's decision affects the next day's decision, the model and the actual operation may continue to diverge. The HEC-5 model also cannot take into account any deviations from the rule curves that may occur, such as operating constraints of the reservoir system based on conditions downstream at locations other than the control points configured in the model.

It should be noted that in the calibration of the model, the rule curves were not always followed as spelled out by the Water Control Manuals. However, by using the same rule curves for all conditions, the relative difference between baseline conditions and the project scenarios can be shown. The affect to the reservoir and downstream conditions can then be estimated.

Baseline Conditions

The calibrated HEC-5 model was then used to establish baseline conditions. Inflows that were adjusted to current level of development (Year 2000) were configured in the model. The Denver Water Board (DWB), through the Colorado Water Conservation Board (CWCB), owns 11,000 acre-feet of storage in Chatfield Reservoir. The DWB is allowed to regulate flow of water into and out of Chatfield Reservoir between the elevations of 5432 and 5423 ft msl. The elevation may drop below 5423 ft msl in times of severe or prolonged drought conditions as reasonably determined by the CWCB. In addition, the reservoir is operated as nearly as practicable to maintain a pool of at least 5426 ft msl during the period of May 1st through August 31st of each year for outdoor recreational uses. The HEC-5 model was configured so that no water supply flows were released whenever the reservoir fell below 5423 ft msl from January through April and September through December. In addition, no water supply flows were released whenever the reservoir dropped below 5426 ft msl during the months of May thru August. The current reservoir regulation criteria listed in the Water Control Manuals for the three reservoirs was configured in the model. Table 7 lists the calibrated models regulation criteria used as compared to the current Water Control regulation criteria. A simulation period of 1942 through 2000 was used.

From the information developed, pool and outflow duration relationships were developed for Chatfield, Bear Creek, and Cherry Creek reservoirs. Flow duration relationships were developed at the Denver, Henderson, Kersey, and Julesburg gages on the South Platte River. Duration relationships were computed using HEC's statistical computer program STATS (HEC,1987) and were computed on an annual, monthly, and seasonal basis. The seasonal was for winter (Jan-Mar), spring (Apr-Jun), summer (Jul-Sep), and fall (Oct-Dec). Annual pool and outflow duration relationships for Chatfield Reservoir are shown in Figures 8 and 9 and listed in Table 8. Annual pool duration relationships for Cherry Creek and Bear Creek Reservoirs are listed in Table 9. Annual flow duration values for the South Platte River at Denver and Henderson are listed in Table 10. Duration relationships on an annual, monthly, and seasonal basis can be found in Appendix H-C for all locations.

Table 7
Comparison of Calibrated and Baseline Regulation Criteria

Location	Regulation Criteria	Calibrated Model	Water Control Manual
	Maximum allowable daily increase	Not used	500 cfs/day
Chatfield Dam	Maximum total daily outflow	2,100 / 3,100 cfs/day[1]	5000 cfs/day
	Maximum allowable daily increase	200 cfs/day	200 cfs/day
Bear Creek Dam	Maximum total daily outflow	600 cfs/day	2000 cfs/day
	Maximum allowable daily increase	200 cfs/day	500 cfs/day
Cherry Creek Dam	Maximum total daily outflow	500 cfs/day	5000 cfs/day
Denver Control Point	Target flow	3,500 / 4,200 cfs[1]	5,000 cfs
Henderson Control Point	Target flow	4,600 / 5,100 cfs[1]	n/a[2]
Kersey Control Point	Target flow	7,000 cfs	n/a
Julesburg Control Point	Target flow	8,000 cfs	n/a

Note: [1]First value used for the 1983 high flow event. Second value used for the 1995 high flow event
[2] n/a – The Water Control Manual only has target flows at Denver

Pool probability relationships were developed for Chatfield, Bear Creek, and Cherry Creek reservoirs based on the Weibull plotting position. The Weibull plotting position is a graphical method of a frequency analysis based on the number of years of observed annual maximum pool records. The curves were ocularly fitted to the data. The pool probability curve for Chatfield Reservoir is shown in Figure 10. Pool values for the 2 through 500-year return period are listed in Table 11 for all three reservoirs.

For the reservoir outflow probability relationships, since the flows were controlled releases from the reservoir, the log-Pearson Type III distribution was not used. Instead, the annual maximum outflows were plotted based on the Weibull plotting position. A curve was then drawn through the data up to the maximum outflow allowed by the Water Control Manual. The curve was then straight lined at the maximum allowed outflow until the frequency at which the pool probability curve would reach the crest of the uncontrolled spillways. Since the elevations of the spillway crests were beyond the 500-year event for all three reservoirs based on the pool probability curves, the flow was assumed to stay at the maximum outflow allowed. The Chatfield Reservoir outflow probability curve is shown in Figure 11. Reservoir outflows for the 2- through 500-year return period are listed in Table 12 for all three reservoirs.

On the South Platte River, flow probability relationships were developed at the Denver, Henderson, Kersey, and Julesburg gages. The annual maximum daily flow first had to be converted to an instantaneous peak flow utilizing the regression equations discussed in the section titled, *Conversion of Annual Maximum Daily Flows to Instantaneous Peak Flows* and the parameters listed in Table 5. Flow probability relationships were then computed based on the methodology presented in Bulletin 17B (WRC,1981) utilizing the log-Pearson type III distribution. A top-half analysis was performed on the Denver and Henderson gage locations which gave a better fit to the historical peaks when plotted graphically. A top-half analysis only utilizes the highest 50% of annual peak discharges in the log Pearson Type III analysis. Flow probabilities for the South Platte River are shown graphically in Figures 12 through 15 and listed in Table 12 for all four locations.

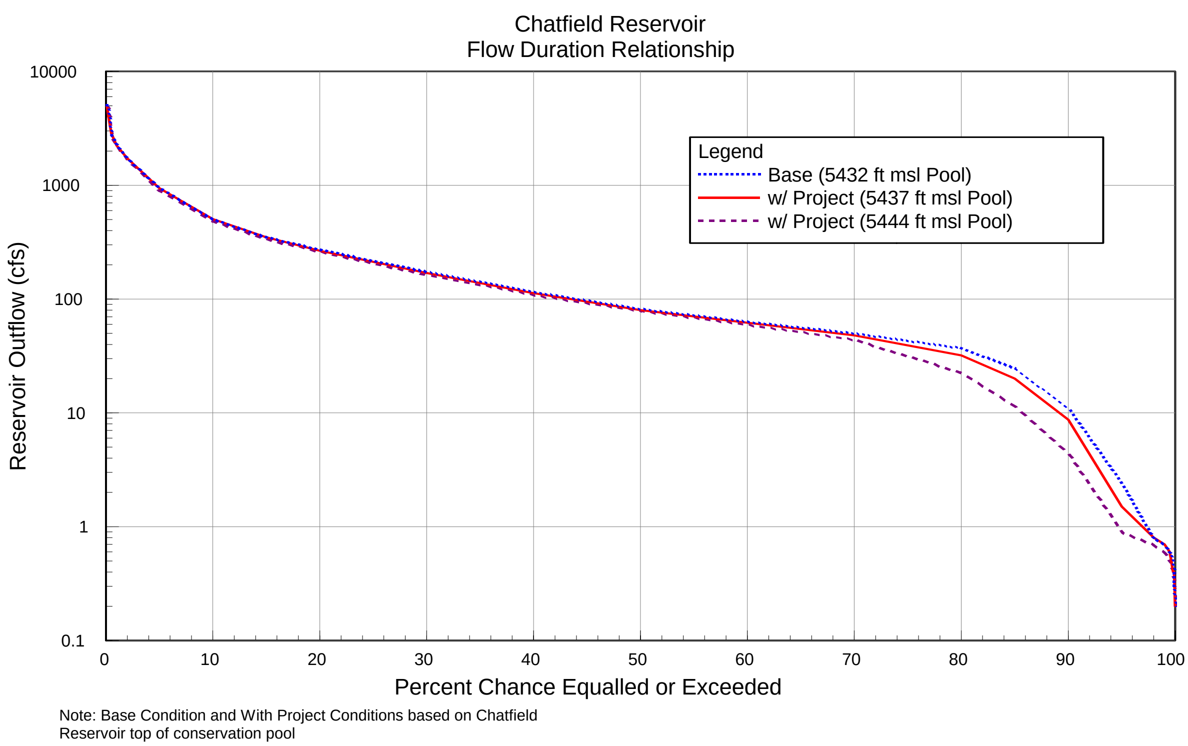
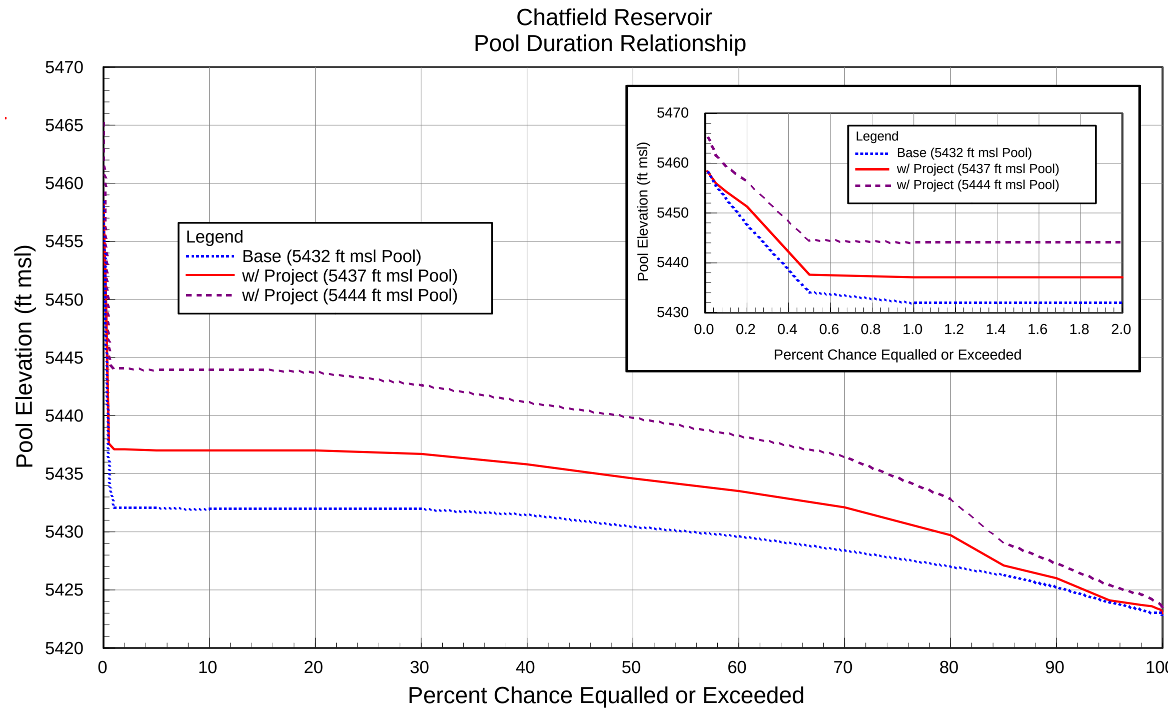
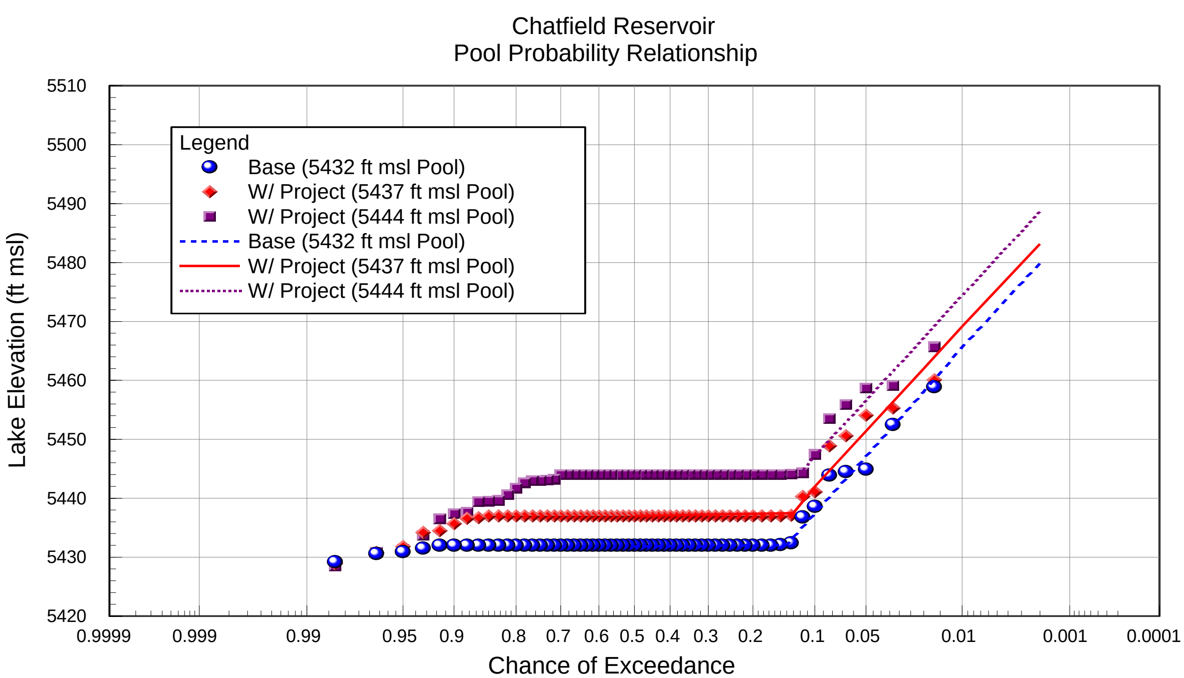


Figure 8 – Flow Duration Relationship – Chatfield Reservoir



Note: Base Condition and With Project Conditions based on Chatfield Reservoir top of conservation pool

Figure 9 – Pool Duration Relationship – Chatfield Reservoir



Note: Base Condition and With Project Conditions based on Chatfield Reservoir top of conservation pool

Figure 10 – Chatfield Reservoir Pool Probability Relationship

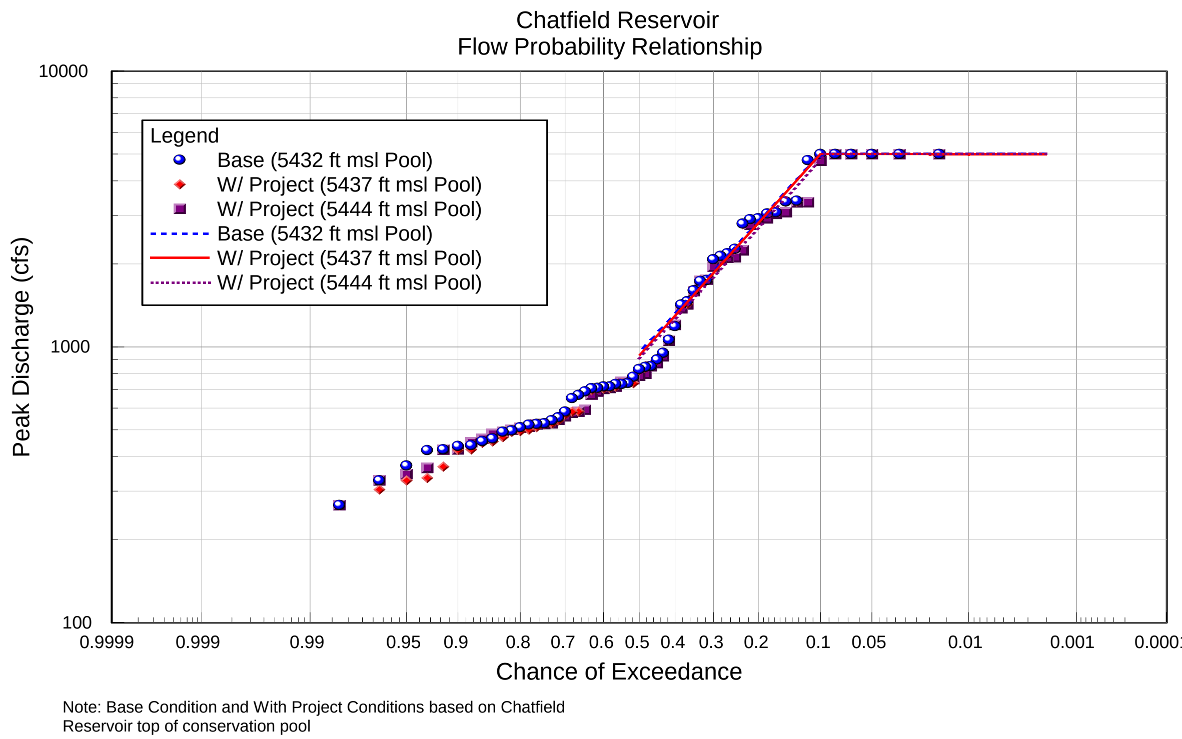


Figure 11 - Chatfield Reservoir Flow Probability Relationship

With Project Conditions.

With baseline conditions established, two different storage reallocation alternatives were evaluated for Chatfield Reservoir. A conservation pool raise of 5 feet and 12 feet for flood control storage reductions of 7,700 and 20,600 acre-feet, respectively. No evaluation was performed of a potential conservation pool raise at Bear Creek or Cherry Creek Reservoirs. The simulation was evaluated using the existing regulation criteria found in the Water Control Manuals. Daily water right storable flows and releases for the pool reallocations were furnished by the State of Colorado for the period of record and are listed in Appendix H-B as average monthly flow data. Values given are for the conservation pool raise of 12 feet. For the 5 foot raise, the flow values were reduced by 63.0 percent which is the ratio of the potential additional conservation pool storage of 7,700 and 20,600 acre-feet for the 5 and 12 foot conservation pool raise, respectively. Flows Daily values were imported to HEC-DSS and configured in the HEC-5 model. Water supply flows for Denver and other senior water right users were the same as those included in the calibration and base condition models. For modeling the with project conditions, the new water supply users were separated into two groups. The first group will release their water right allocations from the reservoir and divert it further downstream on the South Platte River while the second group will divert their water directly from Chatfield Reservoir and not release it downstream. The entities were divided into the following:

Downstream Users (water sent downstream thru Chatfield)

City of Aurora
City of Brighton
Central Colorado Water Conservancy District
Western Mutual Ditch Company
Colorado Division of Parks and Outdoor Recreation
Denver Botanic Gardens

Upstream Users (water diverted out of Chatfield and not routed downstream)

South Metro Water Supply Authority
Parker Water and Sanitation District
Centennial Water and Sanitation District
Town of Castle Rock
Roxborough Metropolitan District
Castle Pines North Metropolitan District
Castle Pines Metropolitan District
Hock Hocking LLC.
Perry Park Country Club
Central Colorado Water Conservancy District

For Upstream Users, the HEC-5 model was configured with the water supply diverted directly out of Chatfield and not routed downstream. For water supply flows that are sent downstream from Chatfield, the Cities of Aurora and Brighton, Central Colorado Water Conservancy District and Western Mutual Ditch Company are diverted out of the South Platte River between the Henderson and Kersey gages. Water supply flows for The Colorado Division of Parks and Outdoor Recreation and the Denver Botanic Gardens are left in-stream and not diverted from the model.

For each with project condition evaluated, pool and outflow probability and annual, monthly, and seasonal pool duration relationships were developed for each reservoir. Annual pool and outflow durations for Chatfield Reservoir are listed in Table 7. Annual pool durations for Cherry Creek and Bear Creek Reservoirs are listed in Table 8. Pool probability relationships for all three reservoirs are listed in Table 10. Annual, monthly and seasonal flow duration relationships were developed at each of the downstream control points on the South Platte, including Denver and Henderson. Annual flow duration values are listed in Table 9 for Denver and Henderson. Flow probability relationships were developed for these locations after converting the annual maximum daily flow to an instantaneous peak flow and are shown on Figures 11 through 14 and listed in Table 11. Annual, monthly, and seasonal pool and flow duration relationships for the three reservoirs and the control points downstream on the South Platte are listed in Appendix H-C.

Table 8
Chatfield Reservoir Annual Duration Relationships
Base and With Project Conditions

Percent of Time Equaled or Exceeded	Chatfield Reservoir Pool Elevation (ft msl)			Chatfield Reservoir Outflow (cfs)		
	Base (5432.0)[1]	w/ Project (5437.0)[1]	w/ Project (5444.0)[1]	Base (5432.0)[1]	w/ Project (5437.0)[1]	w/ Project (5444.0)[1]
0.01	5458.5	5458.4	5465.3	5000	5000	5000
0.05	5455.7	5456.0	5461.8	5000	5000	5000
0.1	5452.9	5454.3	5459.4	5000	5000	5000
0.2	5447.9	5451.3	5456.5	4496	4289	4734
0.5	5434.1	5437.6	5444.6	2799	2849	2763
1	5432.1	5437.1	5444.1	2259	2240	2208
2	5432.1	5437.1	5444.1	1741	1721	1700
5	5432.1	5437.0	5444.0	958	942	910
10	5432.0	5437.0	5444.0	508	505	488
15	5432.0	5437.0	5444.0	354	349	342
20	5432.0	5437.0	5443.8	271	266	262
30	5432.0	5436.7	5442.7	175	170	165
40	5431.5	5435.8	5441.2	117	113	109
50	5430.5	5434.6	5439.9	83	80	79
60	5429.6	5433.5	5438.3	64	62	60
70	5428.4	5432.1	5436.5	51	48	44
80	5427.0	5429.7	5432.9	37	32	23
85	5426.3	5427.1	5429.1	25	20	11.6
90	5425.3	5426.0	5427.3	11	8.7	4.4
95	5424.0	5424.1	5425.5	2.4	1.5	0.9
98	5423.3	5423.7	5424.6	0.8	0.8	0.7
99	5423.0	5423.6	5424.3	0.7	0.7	0.6
99.5	5423.0	5423.4	5424.0	0.6	0.6	0.5
99.8	5423.0	5423.3	5423.8	0.5	0.4	0.4
99.9	5423.0	5423.2	5423.6	0.4	0.4	0.3

Note: [1]Elevation at Chatfield Reservoir top of conservation pool.

Table 9
Bear Creek and Cherry Creek Reservoirs
Annual Pool Duration Relationships
Base and With Project Conditions

Percent of Time Equaled or Exceeded	Bear Creek Reservoir Pool Elevation (ft msl)			Cherry Creek Reservoir Pool Elevation (ft msl)		
	Base (5432.0)[1]	w/ Project (5437.0)[1]	w/ Project (5444.0)[1]	Base (5432.0)[1]	w/ Project (5437.0)[1]	w/ Project (5444.0)[1]
0.01	5589.7	5590.5	5590.5	5559.8	5559.8	5560.8
0.05	5580.1	5583.4	5583.2	5554.1	5556.1	5555.1
0.1	5572.9	5577.8	5576.2	5551.2	5551.5	5552.0
0.2	5565.8	5567.0	5566.6	5550.4	5550.3	5550.2
0.5	5562.1	5562.2	5562.1	5550.1	5550.1	5550.1
1	5561.4	5561.4	5561.4	5550.1	5550.1	5550.1
2	5560.9	5560.9	5560.9	5550.1	5550.1	5550.1
5	5560.3	5560.3	5560.3	5550.1	5550.1	5550.1
10	5559.8	5559.8	5559.8	5550.0	5550.0	5550.0
15	5559.3	5559.3	5559.3	5550.0	5550.0	5550.0
20	5559.0	5559.0	5559.0	5550.0	5550.0	5550.0
30	5558.6	5558.6	5558.6	5550.0	5550.0	5550.0
40	5558.4	5558.4	5558.4	5550.0	5550.0	5550.0
50	5558.3	5558.3	5558.3	5550.0	5550.0	5550.0
60	5558.3	5558.3	5558.3	5550.0	5550.0	5550.0
70	5558.2	5558.2	5558.2	5549.8	5549.8	5549.8
80	5558.2	5558.2	5558.2	5549.5	5549.5	5549.5
85	5558.1	5558.1	5558.1	5549.3	5549.3	5549.3
90	5558.1	5558.1	5558.1	5549.1	5549.1	5549.1
95	5558.1	5558.1	5558.1	5548.9	5548.9	5548.9
98	5558.0	5558.0	5558.0	5548.8	5548.8	5548.8
99	5558.0	5558.0	5558.0	5548.7	5548.7	5548.7
99.5	5558.0	5558.0	5558.0	5548.7	5548.7	5548.7
99.8	5558.0	5558.0	5558.0	5548.7	5548.7	5548.7
99.9	5558.0	5558.0	5558.0	5548.6	5548.6	5548.6

Note: [1]Elevation at Chatfield Reservoir top of conservation pool.

Table 10
South Platte River Annual Duration Relationships
Base and With Project Conditions

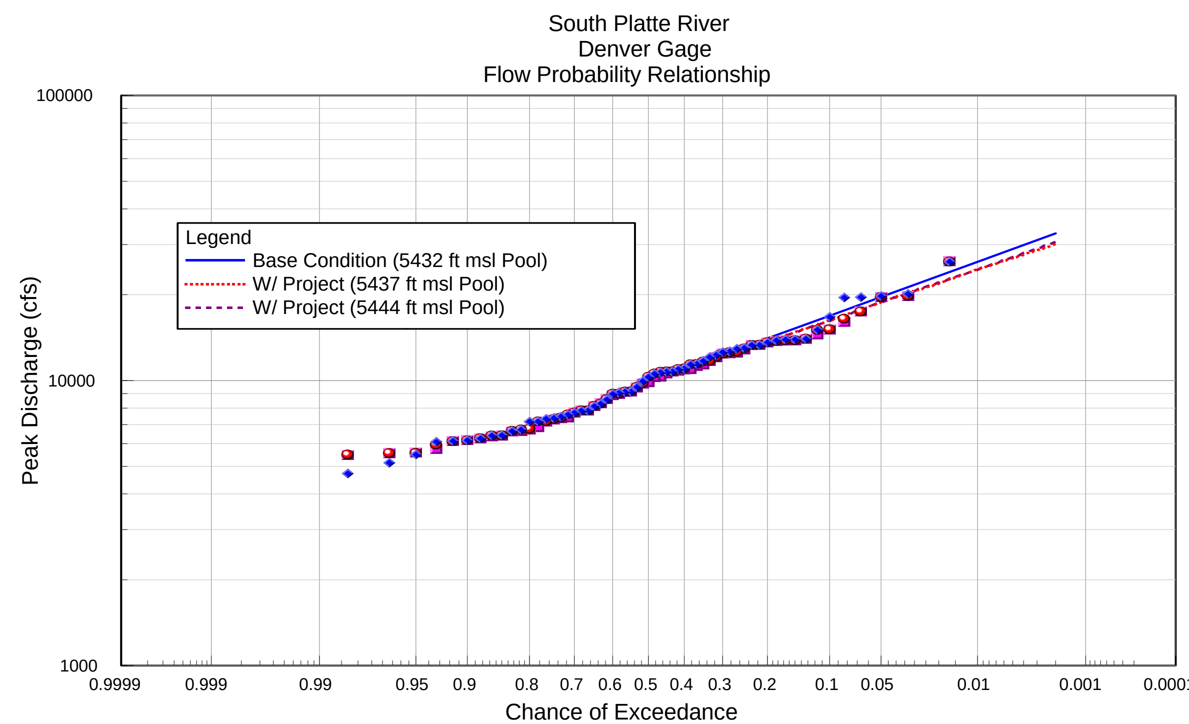
Percent of Time Equaled or Exceeded	South Platte River at Denver Gage (cfs)			South Platte River at Henderson Gage (cfs)		
	Base (5432.0)[1]	w/ Project (5437.0)[1]	w/ Project (5444.0)[1]	Base (5432.0)[1]	w/ Project (5437.0)[1]	w/ Project (5444.0)[1]
0.01	8668	8679	8664	16676	14768	14768
0.05	6775	6803	6776	11159	10969	10855
0.1	6188	6220	6190	9730	9401	9264
0.2	5575	5609	5569	8199	8135	8010
0.5	4507	4527	4476	6343	6419	6297
1	3575	3557	3500	5033	5092	4990
2	2589	2563	2524	3797	3796	3719
5	1467	1440	1407	2259	2246	2220
10	844	836	813	1348	1343	1328
15	595	589	582	976	973	960
20	474	471	464	773	770	762
30	332	329	326	570	565	562
40	248	245	242	454	450	445
50	198	195	193	373	370	366
60	165	162	159	311	308	305
70	139	137	135	253	251	249
80	115	113	112	203	201	201
85	103	101	100	171	170	170
90	88	87	85	137	136	135
95	67	67	64	101	100	99
98	44	44	42	73	72	70
99	28	30	28	56	56	52
99.5	18	18	18	41	40	38
99.8	13	13	13	26	24	23
99.9	11	11	11	18	17	16

Note: [1]Elevation at Chatfield Reservoir top of conservation pool.

Table 11
Pool Probability - Chatfield, Bear Creek and Cherry Creek Reservoirs
Comparison of Baseline and With Project Conditions

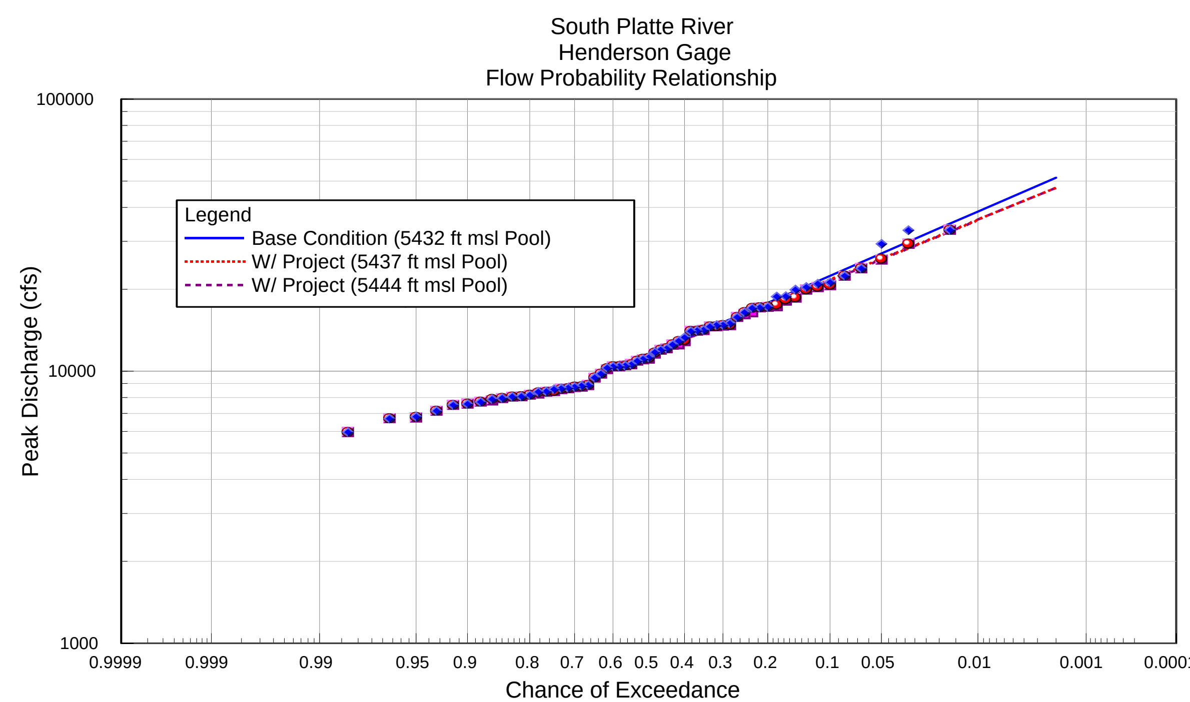
Location	Conservation Pool[1] (ft msl)	Pool Probabilities (ft msl)				
		2-Year	10-Year	50-Year	100-Year	500-Year
	5432	5432.0	5437.5	5458.1	5465.5	5479.7
	5437	5437.0	5442.0	5462.0	5469.2	5483.2
Chatfield Reservoir	5444	5444.0	5447.2	5467.1	5474.3	5488.5
	5432	5560.0	5564.2	5594.0	5606.0	5628.0
	5437	5560.0	5564.2	5594.0	5606.0	5628.0
Bear Creek Reservoir	5444	5560.0	5564.2	5594.0	5606.0	5628.0
	5432	5550.0	5550.5	5563.1	5567.6	5576.7
	5437	5550.0	5550.7	5563.1	5567.6	5576.7
Cherry Creek Reservoir	5444	5550.0	5550.7	5563.1	5567.6	5576.7

[1] Conservation Pool is for Chatfield Reservoir



Note: Base Condition and With Project Conditions based on Chatfield Reservoir top of conservation pool

Figure 12 – South Platte River Flow Probability Relationship - Denver



Note: Base Condition and With Project Conditions based on Chatfield Reservoir top of conservation pool

Figure 13 - South Platte River Flow Probability Relationship - Henderson

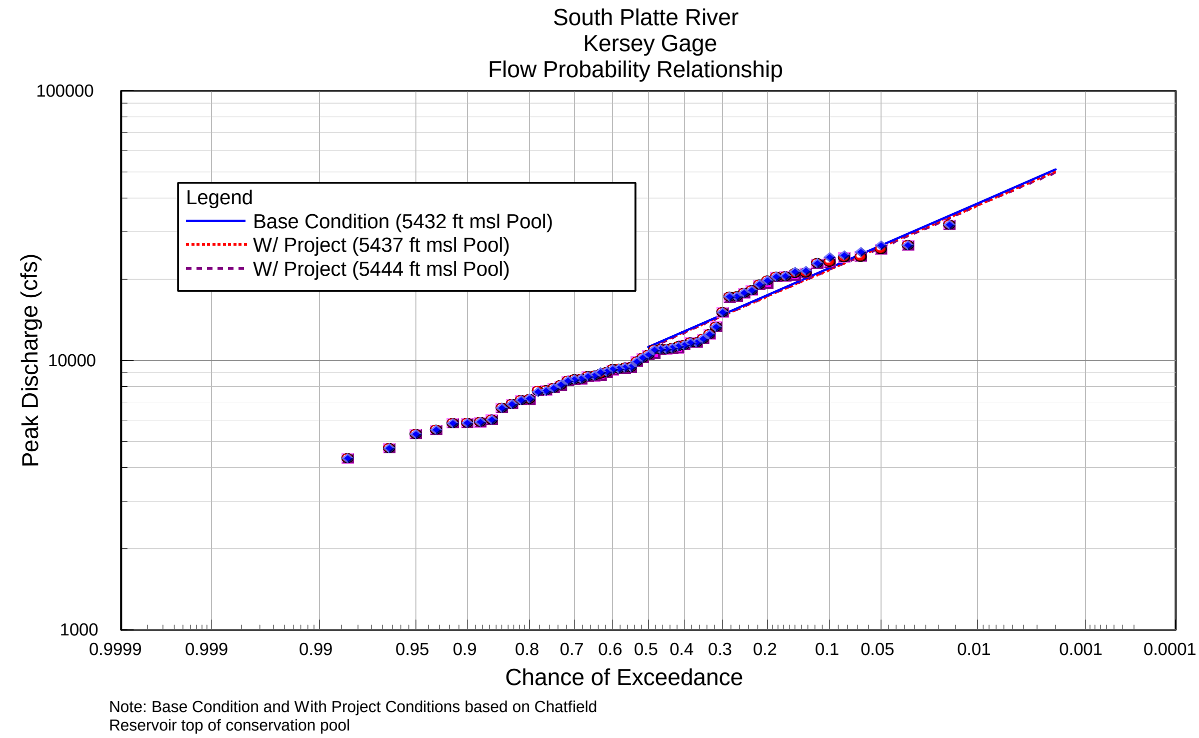


Figure 14 - South Platte River Flow Probability Relationship - Kersey

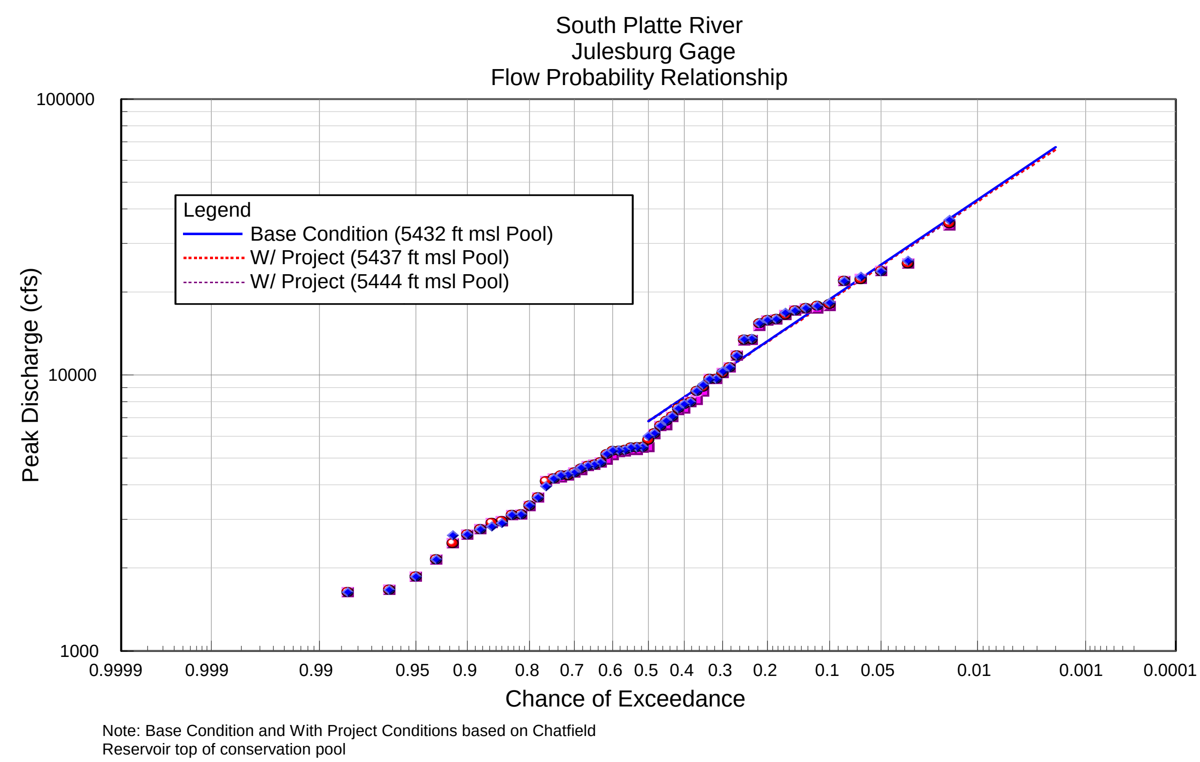


Figure 15 - South Platte River Flow Probability Relationship - Julesburg

Table 12
Peak Discharge Probability - South Platte River Basin, Colorado
Comparison of Baseline and With Project Conditions

Location	Conservation Pool[1] (ft msl)	Peak Discharge Probabilities (cfs) 2-Year	10-Year	50-Year	100-Year	500-Year
	5432	950	4,300	5,000	5,000	5,000
	5437	950	3,800	5,000	5,000	5,000
Chatfield Releases	5444	950	4,000	5,000	5,000	5,000
	5432	230	790	1,750	2,000	2,000
	5437	230	790	1,750	2,000	2,000
Bear Creek Releases	5444	230	790	1,750	2,000	2,000
	5432	150	1,250	5,000	5,000	5,000
	5437	150	1,250	5,000	5,000	5,000
Cherry Creek Releases	5444	150	1,250	4,100	5,000	5,000
	5432	9,800	16,200	21,900	24,300	30,100
	5437	9,700	16,100	21,900	24,300	30,300
Denver	5444	9,700	16,200	22,000	24,500	30,600
	5432	11,600	21,800	31,900	36,500	47,900
	5437	11,500	21,700	31,800	36,400	47,800
Henderson	5444	11,500	21,800	32,100	36,800	48,600
	5432	11,200	21,800	32,600	37,500	50,000
	5437	11,200	21,700	32,400	37,400	49,800
Kersey	5444	11,100	21,700	32,400	37,300	49,800
	5432	6,800	18,600	34,200	42,400	65,500
	5437	6,700	18,500	34,100	42,200	65,300
Julesburg	5444	6,700	18,400	33,800	41,900	64,800

[1] Conservation Pool is for Chatfield Reservoir

Discussion of Results.

There was a vast amount of data generated by this analysis that will be used for assessing the impacts to the flood control, fisheries and wildlife, and recreation both, upstream and downstream of Chatfield Reservoir. This discussion will address general trends based on the annual results when comparing the base and the with project conditions.

For Chatfield Reservoir, obviously increasing the top of the conservation pool for the project conditions increased the percent of time the reservoir was at an elevation higher than the base condition pool of 5432.0. A better way of presenting the data would be to focus on the percent of time the top of conservation pool is equaled or exceeded. For the base condition, the pool was at or above the 5432.0 ft msl pool 30 percent of the time on an annual basis for the period of record. For the two with project conditions, the pool was at or above the top of conservation pool 5437.0 ft msl and 5444.0 ft msl for 20 and 15 percent of the time, respectively. At five feet below the top of conservation pool, the reservoir would equal or exceed that elevation 80 percent of the time for base conditions. For the with project conditions, the pool would be within 5 feet of the top of conservation pool just over 70 percent of the time for the 5437 pool and just under 60 percent of the time for the 5444 pool.

As shown in Table 8, releases from Chatfield into the South Platte River would decrease for the with project conditions when compared to the base conditions with the exception of flow durations that are equaled or exceeded less than 0.5 percent of the time on an annual basis for the 5437 pool and 0.2 percent for the 5444 pool. Releases decreased for with project conditions due in part to the new water supply needs being directly removed from Chatfield without being released downstream on the South Platte. This is coupled with the fact that there is no additional runoff being added from the South Platte River basin upstream of Chatfield, only additional water supply requirements. Also, since Chatfield's pool is below the top of conservation pool more often for the with project conditions, there is a chance that there will be available storage to hold the water instead of passing it through the reservoir if it's in the flood control pool or needed to meet water supply requirements downstream.

Corresponding to the decrease in releases from Chatfield, annual flow durations for downstream on the South Platte River (shown in Table 10) show a slight reduction for the with project conditions when compared to the base condition with the exception of some of the extreme flow events with a 0.5 percent chance of equaling or exceeding. At Denver, for a flow of 198 cfs, which is equaled or exceeded 50 percent of the time, the flow is reduced by 5 cfs (or -2.5%) for the with project condition of a 5444 pool when compared to the base condition. At Henderson, the 50 percent equaled or exceeded flow of 373 cfs is lowered by 7.0 cfs or -1.9%

For pool probabilities, the 100-year pool elevation for Chatfield Reservoir is 5465.5 ft msl for the base condition as shown in Table 11. Increasing the top of conservation pool to 5437.0 ft msl resulted in a 100-year pool of 5469.2 ft msl or an increase of 3.7 feet when compared to the base condition. For the 5444 pool condition, the 100-year pool was 5474.3 ft msl, or an increase of 8.8 feet when compared to the base condition.

Overall for Chatfield Reservoir, the base condition, the 5437 and 5444 pools have nearly identical flow probability relationships as listed in Table 12. The with project condition of the 5437 and 5444 pools had slightly lower outflow values for the 10-year return periods. The 50-, 100-, and 500-year Chatfield outflows are all 5,000 cfs for both, the base condition and the two with project conditions. As was discussed earlier in this write-up, this is due to the releases being constrained to a maximum allowable outflow of 5,000 cfs until the pool reaches the uncontrolled spillway crest.

For Cherry Creek and Bear Creek Reservoirs, there is minimal impact to both, pool elevations and reservoir releases for the with project conditions (See Tables 11 and 12, respectively). The only impact was just a slight decrease in flows for Cherry Creek for the 10- and 50-year return period for the with project condition of a 5444.0 top of conservation pool at Chatfield. This is due to a small change in the priority of releases between Cherry Creek and Chatfield Reservoirs that was dependent upon conditions in the reservoirs during high flow periods for the with project conditions.

On the South Platte River downstream of Chatfield Reservoir, the with project conditions slightly lowered the flooding potential at the two lower control points, Kersey, and Julesburg for the 10- through 500-year events. Flows at the Denver gage either stayed the same or slightly increased for the with project condition of 5444 pool. For instance, from Table 12, when compared to base condition, the 100-year discharge at the Denver gage goes from 24,300 cfs to 24,300 cfs for the 5437 pool (0.0 %) and 24,500 cfs for the 5444 pool (0.8%). These differences are considered negligible and would not warrant any changes in existing flood frequency criteria used for flood plain regulation The 2-year discharges either stayed the same or dropped slightly for the with project conditions.

DEVELOPMENT IN THE FLOOD POOL

If reallocation of part of the flood control pool at Chatfield Reservoir occurs, then any development of facilities for the Recreation Mitigation Plans will be subject to the Corp's Northwest Division's NWD Policy for development proposals in Corps Reservoir lands, NWDR 1110-2-5.

The hydrologic analysis was reevaluated to insure that the revised pool elevations for the reallocation of storage in Chatfield Reservoir are consistent with those defined in NWDR 1110-2-5. The pool elevations defined in NWDR 1110-2-5 for Chatfield Reservoir were derived from both historical pool elevations and modeled results. This differs from the hydrologic analysis for the Chatfield Reallocation Study which was based on modeled results only and results were not adjusted for historic pool elevations. To account for this, the reallocated pools of 5437 ft. msl and 5444 ft. msl were adjusted by assuming that the reservoir would be operated similar to what has been observed historically. Final elevations are shown in Table 13. This results in a rise in the 10-year and 100-year pool elevations and a reduction in the 50-year pool when compared to modeled only values from the Chatfield Reallocation Study. The primary reason for this difference is the model simulation studies included a maximum release of 5,000 cfs while actual historical releases have not exceeded 3,350 cfs.

Table 13
Chatfield Reservoir
NWDR 1110-2-5 for Chatfield Reallocation Pool Elevations

Top of Conservation Pool	Existing (5432)	w/ Project (5437.0	w/ Project (5444.0)
10-Year Pool Level (Zone 1)	5444.5	5448.2	5453.7
50-Year Pool Level (Zone 2)	5456.0	5458.9	5463.7
100-Year Pool Level (Zone 3)	5481.0	5483.1	5486.4

Elevation shown should be used for The Recreation Mitigation Plans for the Chatfield Reallocation Study per NWDR 1110-2-5.

OBSERVATIONS

The purpose of this study was to perform a hydrologic evaluation of the potential impacts to flood control, fisheries and wildlife, and recreation both, upstream and downstream of Chatfield Reservoir due to the potential reallocation of storage from flood control to multi-purpose use. This analysis also included quantifying the potential impacts to Cherry Creek and Bear Creek Reservoirs. A summary of the model development and findings are as follows:

- There were no historic water supply records available for Chatfield Reservoir and had to be estimated.
- Local inflows downstream of Chatfield Reservoir were adjusted to year 2000 level of development for the period of record to account for urbanization in the basin. No such adjustment was necessary upstream of any of the three reservoirs.
- During the calibration of the model, it was shown that the rule curves are not always strictly adhered to since they cannot anticipate every situation that may arise during flooding nor allow for engineering judgment.
- While both the historic and potentially new water supply estimates may not be accurate and not necessarily an indication of how water may be allocated in the future, the HEC-5 model was able to show the relative differences when comparing the base condition for the existing multipurpose pool and the with project conditions and their potential impacts.
- The pool in Chatfield Reservoir will be below the top of the conservation pool more often and will experience more fluctuation for the with project conditions.
- Less flow will be released from Chatfield to the South Platte River.
- Peak flood flows downstream of Chatfield on the South Platte River either stay the same or are slightly lower for the 2- thorough 500-year events for both, the 5437 and 5444 pools.
- The project conditions have minimal or no impact on Cherry Creek and Bear Creek pool elevations and reservoir releases.

REFERENCES

ArcView GIS 3.2 Software Program. Environmental Systems Research Institute, Inc. Redlands, California, 1999

Bear Creek Dam and Reservoir Water Control Manual. United States Army Corps of Engineers, Omaha District, November 1977.

Chatfield Dam and Reservoir Water Control Manual. United States Army Corps of Engineers, Omaha District, May 1973.

Cherry Creek Dam and Reservoir Water Control Manual. United States Army Corps of Engineers, Omaha District, April 1971.

Guidelines for Determining Flood Flow Frequency – Bulletin 17B. Interagency Advisory Committee on Water Data. U.S. Department of the Interior, Geological Survey, Reston, Virginia, September 1981.

HEC-FFA, Flood Frequency Analysis User's Manual. U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC), Davis, California, May 1992.

HEC-5, Simulation of Flood Control and Conservation Systems Hydrologic Modeling System User's Manual. U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC), Davis, California, October 1998.

HEC-DSS, Data Storage System User's Manual. U.S. Army Corps of Engineers, Hydrologic Engineering Center (HEC), Davis, California, March 1995.

OTHA, Omaha Tools for Hydrologic Analysis. U.S. Army Corps of Engineers, Omaha District, Omaha , Nebraska, April 2004.

STATS, Statistical Analysis of Time Series Data User's Manual. Hydrologic Engineering Center (HEC), Davis, California, May 1987

APPENDIX H-A

INCREMENTAL INFLOW ADJUSTMENT
TO YEAR 2000 DEVELOPMENT

ANNUAL AVERAGE DAILY INFLOW, YEAR USED TO DEVELOP WATER RIGHT DEMANDS, AND ESTIMATED HISTORIC WATER RIGHT DEMANDS

SOUTH PLATTE RIVER

DENVER, HENDERSON, KERSEY, AND JULESBURG REACHES

Table H-A-1

Incremental Inflow - Denver Reach

Inflows adjusted to Year 2000 level of Development

Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor	Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor[1]
1942	116347	18814	81870	179403	1.54	1972	33025	51429	81870	63466	1.92
1943	22737	19901	81870	84706	3.73	1973	91677	52516	81870	121031	1.32
1944	25684	20988	81870	86566	3.37	1974	41542	53604	81870	69809	1.68
1945	34052	22075	81870	93848	2.76	1975	47851	54691	81870	75031	1.57
1946	23535	23162	81870	82243	3.49	1976	33098	55778	81870	59190	1.79
1947	56240	24250	81870	113861	2.02	1977	22596	56865	81870	47602	2.11
1948	29344	25337	81870	85877	2.93	1978	33078	57952	81870	56996	1.72
1949	41122	26424	81870	96568	2.35	1979	71512	59040	81870	94343	1.32
1950	16365	27511	81870	70724	4.32	1980	79067	60127	81870	100810	1.28
1951	16377	28598	81870	69649	4.25	1981	45277	61214	81870	65933	1.46
1952	22498	29686	81870	74683	3.32	1982	54465	62301	81870	74034	1.36
1953	12341	30773	81870	63439	5.14	1983	136264	63388	81870	154746	1.14
1954	11511	31860	81870	61522	5.34	1984	98608	64475	81870	116003	1.18
1955	12500	32947	81870	61424	4.91	1985	84712	65563	81870	101020	1.19
1956	12387	34034	81870	60223	4.86	1986	65362	66650	81870	80582	1.23
1957	27803	35122	81870	74552	2.68	1987	103200	67737	81870	117333	1.14
1958	26133	36209	81870	71795	2.75	1988	76437	68824	81870	89483	1.17
1959	21884	37296	81870	66458	3.04	1989	69911	69911	81870	81870	1.17
1960	27102	38383	81870	70589	2.60	1990	79965	70999	81870	90837	1.14
1961	33308	39470	81870	75708	2.27	1991	76020	72086	81870	85804	1.13
1962	19538	40557	81870	60851	3.11	1992	72386	73173	81870	81084	1.12
1963	12441	41645	81870	52667	4.23	1993	58414	74260	81870	66025	1.13
1964	10180	42732	81870	49319	4.84	1994	50110	75347	81870	56633	1.13
1965	41078	43819	81870	79129	1.93	1995	90222	76435	81870	95658	1.06
1966	18205	44906	81870	55170	3.03	1996	65159	77522	81870	69508	1.07
1967	27412	45993	81870	63289	2.31	1997	80750	78609	81870	84011	1.04
1968	19083	47081	81870	53873	2.82	1998	93877	79696	81870	96052	1.02
1969	101509	48168	81870	135212	1.33	1999	89735	80783	81870	90822	1.01
1970	85346	49255	81870	117962	1.38	2000	60062	81870	81870	60062	1.00
1971	41741	50342	81870	73269	1.76						

[1] Note – Correction Factor applied to daily flow values for that year to adjust to Year 2000 development

Table H-A-2

Incremental Inflow - Henderson Reach

Inflows adjusted to Year 2000 level of Development

Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor	Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor[1]
1942	114988	36899	181218	259307	2.26	1972	114238	111547	181218	183909	1.61
1943	35427	39387	181218	177258	5.00	1973	220792	114035	181218	287975	1.30
1944	23267	41875	181218	162609	6.99	1974	176374	116523	181218	241069	1.37
1945	46667	44364	181218	183522	3.93	1975	116724	119011	181218	178930	1.53
1946	22793	46852	181218	157159	6.90	1976	91358	121500	181218	151077	1.65
1947	76343	49340	181218	208221	2.73	1977	79243	123988	181218	136473	1.72
1948	72944	51828	181218	202333	2.77	1978	104773	126476	181218	159514	1.52
1949	70116	54317	181218	197017	2.81	1979	120326	128965	181218	172579	1.43
1950	34838	56805	181218	159251	4.57	1980	177536	131453	181218	227302	1.28
1951	63795	59293	181218	185719	2.91	1981	78096	133941	181218	125372	1.61
1952	49538	61781	181218	168975	3.41	1982	100028	136429	181218	144817	1.45
1953	50947	64270	181218	167895	3.30	1983	311661	138918	181218	353962	1.14
1954	17460	66758	181218	131920	7.56	1984	283477	141406	181218	323289	1.14
1955	27886	69246	181218	139857	5.02	1985	149000	143894	181218	186323	1.25
1956	51404	71735	181218	160887	3.13	1986	126330	146382	181218	161165	1.28
1957	137294	74223	181218	244290	1.78	1987	121606	148871	181218	153953	1.27
1958	66511	76711	181218	171018	2.57	1988	124690	151359	181218	154550	1.24
1959	35930	79199	181218	137949	3.84	1989	99240	153847	181218	126611	1.28
1960	54618	81688	181218	154148	2.82	1990	108044	156335	181218	132927	1.23
1961	99907	84176	181218	196949	1.97	1991	122877	158824	181218	145272	1.18
1962	74739	86664	181218	169293	2.27	1992	132089	161312	181218	151995	1.15
1963	28835	89152	181218	120900	4.19	1993	111040	163800	181218	128458	1.16
1964	50374	91641	181218	139951	2.78	1994	79762	166288	181218	94692	1.19
1965	155514	94129	181218	242603	1.56	1995	282189	168777	181218	294631	1.04
1966	53466	96617	181218	138067	2.58	1996	150635	171265	181218	160588	1.07
1967	80177	99105	181218	162290	2.02	1997	233971	173753	181218	241436	1.03
1968	57383	101594	181218	137007	2.39	1998	160570	176241	181218	165546	1.03
1969	106764	104082	181218	183900	1.72	1999	239776	178730	181218	242264	1.01
1970	166331	106570	181218	240979	1.45	2000	129029	181218	181218	129029	1.00
1971	162723	109058	181218	234882	1.44						

[1] Note – Correction Factor applied to daily flow values for that year to adjust to Year 2000 development

Table H-A-3

Incremental Inflow - Kersey Reach

Inflows adjusted to Year 2000 level of Development

Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor	Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor[1]
1942	655554	274647	562330	943237	1.44	1972	235033	423448	562330	373914	1.59
1943	263495	279607	562330	546218	2.07	1973	882132	428408	562330	1016053	1.15
1944	244153	284567	562330	521916	2.14	1974	309271	433368	562330	438232	1.42
1945	228477	289527	562330	501280	2.19	1975	330460	438328	562330	454461	1.38
1946	159121	294487	562330	426963	2.68	1976	227314	443288	562330	346356	1.52
1947	508908	299447	562330	771791	1.52	1977	155091	448248	562330	269172	1.74
1948	227491	304407	562330	485414	2.13	1978	297707	453208	562330	406828	1.37
1949	496339	309367	562330	749302	1.51	1979	763225	458169	562330	867386	1.14
1950	144166	314327	562330	392169	2.72	1980	1162276	463129	562330	1261477	1.09
1951	270864	319287	562330	513907	1.90	1981	220615	468089	562330	314856	1.43
1952	367915	324247	562330	605998	1.65	1982	329291	473049	562330	418572	1.27
1953	163532	329207	562330	396654	2.43	1983	1638253	478009	562330	1722574	1.05
1954	94155	334167	562330	322317	3.42	1984	954249	482969	562330	1033610	1.08
1955	106745	339127	562330	329947	3.09	1985	405818	487929	562330	480219	1.18
1956	106414	344087	562330	324657	3.05	1986	625755	492889	562330	695196	1.11
1957	495679	349047	562330	708961	1.43	1987	412511	497849	562330	476991	1.16
1958	591615	354007	562330	799938	1.35	1988	259812	502809	562330	319332	1.23
1959	303001	358968	562330	506363	1.67	1989	256821	507769	562330	311381	1.21
1960	260227	363928	562330	458629	1.76	1990	337294	512729	562330	386895	1.15
1961	738400	368888	562330	931842	1.26	1991	335332	517689	562330	379973	1.13
1962	385283	373848	562330	573764	1.49	1992	332333	522649	562330	372013	1.12
1963	189294	378808	562330	372816	1.97	1993	335485	527609	562330	370206	1.10
1964	148023	383768	562330	326585	2.21	1994	232476	532569	562330	262236	1.13
1965	519067	388728	562330	692668	1.33	1995	985967	537529	562330	1010767	1.03
1966	145219	393688	562330	313861	2.16	1996	429823	542489	562330	449663	1.05
1967	346641	398648	562330	510322	1.47	1997	855127	547449	562330	870007	1.02
1968	182101	403608	562330	340822	1.87	1998	387860	552410	562330	397780	1.03
1969	594219	408568	562330	747980	1.26	1999	750363	557370	562330	755323	1.01
1970	507299	413528	562330	656100	1.29	2000	238015	562330	562330	238015	1.00
1971	561713	418488	562330	705555	1.26						

[1] Note – Correction Factor applied to daily flow values for that year to adjust to Year 2000 development

Table H-A-4

Incremental Inflow - Julesburg Reach

Inflows adjusted to Year 2000 level of Development

Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor	Year	Annual Volume (ac-ft)	Linear Reg Volume (ac-ft)	Baseline Volume (ac-ft)	Adjusted Volume (ac-ft)	Correction Factor[1]
1942	40445	24214	30382	46613	1.15	1972	3582	27404	30382	6560	1.83
1943	56549	24320	30382	62611	1.11	1973	94771	27510	30382	97642	1.03
1944	5473	24426	30382	11429	2.09	1974	27102	27617	30382	29867	1.10
1945	12225	24533	30382	18074	1.48	1975	12113	27723	30382	14771	1.22
1946	45532	24639	30382	51274	1.13	1976	2652	27829	30382	5204	1.96
1947	12628	24745	30382	18265	1.45	1977	7695	27936	30382	10141	1.32
1948	38555	24852	30382	44085	1.14	1978	0	28042	30382	0	1.00
1949	46592	24958	30382	52016	1.12	1979	8898	28149	30382	11131	1.25
1950	21083	25065	30382	26400	1.25	1980	55364	28255	30382	57491	1.04
1951	9468	25171	30382	14679	1.55	1981	4548	28361	30382	6568	1.44
1952	22688	25277	30382	27792	1.22	1982	7521	28468	30382	9435	1.25
1953	4343	25384	30382	9341	2.15	1983	63837	28574	30382	65645	1.03
1954	1118	25490	30382	6010	5.37	1984	54584	28680	30382	56286	1.03
1955	5636	25596	30382	10421	1.85	1985	43457	28787	30382	45053	1.04
1956	0	25703	30382	0	1.00	1986	29409	28893	30382	30898	1.05
1957	4944	25809	30382	9517	1.92	1987	24444	28999	30382	25826	1.06
1958	57263	25915	30382	61729	1.08	1988	51937	29106	30382	53213	1.02
1959	23845	26022	30382	28205	1.18	1989	4591	29212	30382	5761	1.25
1960	6376	26128	30382	10629	1.67	1990	19509	29318	30382	20572	1.05
1961	5047	26234	30382	9194	1.82	1991	12470	29425	30382	13427	1.08
1962	36325	26341	30382	40366	1.11	1992	31579	29531	30382	32430	1.03
1963	19651	26447	30382	23586	1.20	1993	44884	29637	30382	45629	1.02
1964	421	26553	30382	4250	10.08	1994	7357	29744	30382	7995	1.09
1965	105594	26660	30382	109317	1.04	1995	3056	29850	30382	3588	1.17
1966	44718	26766	30382	48334	1.08	1996	51987	29956	30382	52412	1.01
1967	16450	26872	30382	19959	1.21	1997	25390	30063	30382	25709	1.01
1968	52639	26979	30382	56042	1.06	1998	46754	30169	30382	46967	1.00
1969	7486	27085	30382	10782	1.44	1999	45963	30275	30382	46069	1.00
1970	88842	27191	30382	92032	1.04	2000	19074	30382	30382	19074	1.00
1971	14107	27298	30382	17191	1.22						

[1] Note – Correction Factor applied to daily flow values for that year to adjust to Year 2000 development

Table H-A-5
Annual Average Daily Inflow, Year Used to Develop Water Right Demands, and Estimated Historic Water Right Demands

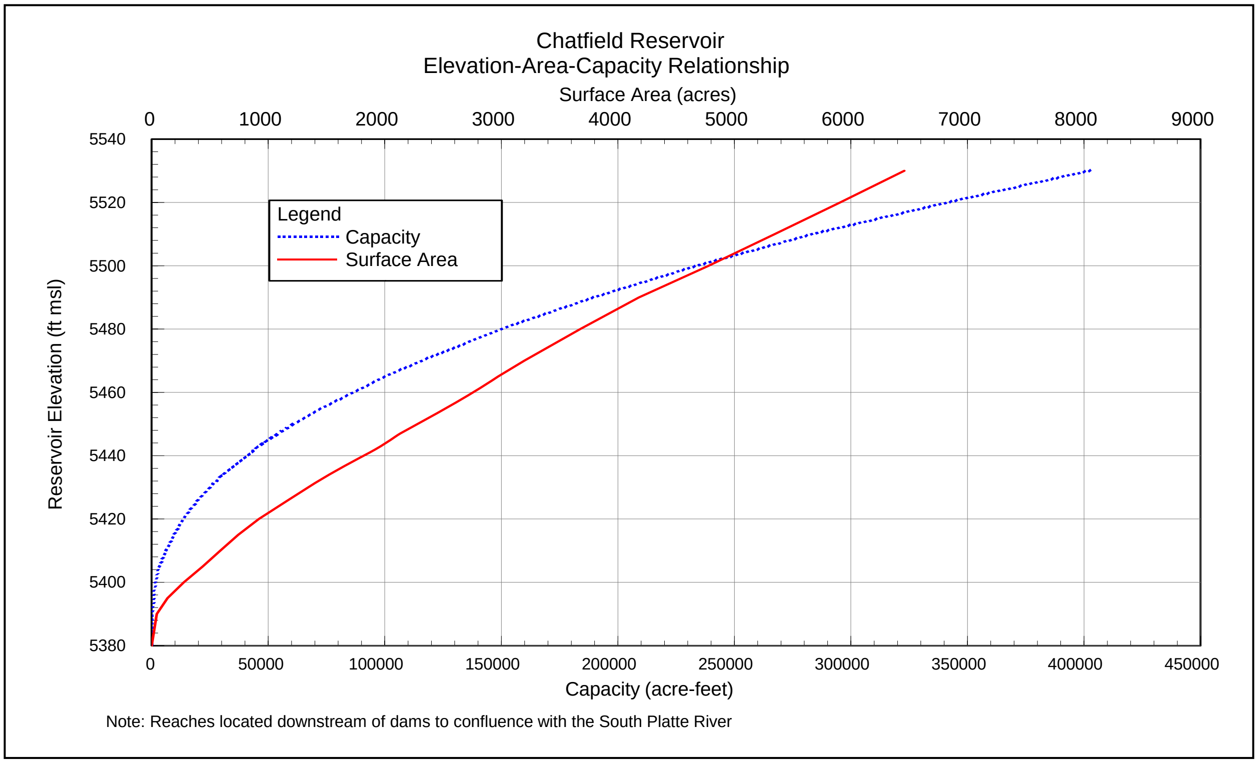
Year	Annual Average Daily Inflow (cfs)	Water Right Demand Year Used (year)	Water Right Demand Average Daily Flow (cfs)	Year	Annual Average Daily Inflow (cfs)	Water Right Demand Year Used (year)	Water Right Demand Average Daily Flow (cfs)
1942	784.4	1983	134.1	**1972**	111.2	1996	95.9
1943	133.3	1989	125.6	**1973**	589.0	1983	134.3
1944	221.0	1979	149.7	**1974**	161.6	1997	101.3
1945	233.2	1979	149.9	**1975**	174.0	1989	126.1
1946	126.7	2000	103.5	**1976**	145.3	------	142.1
1947	429.0	1995	116.2	**1977**	106.8	------	102.3
1948	427.6	1995	115.6	**1978**	93.1	------	91.3
1949	445.5	1995	116.1	**1979**	223.3	------	149.7
1950	87.7	1978	91.7	**1980**	469.4	------	99.0
1951	108.0	1977	102.2	**1981**	81.6	------	60.2
1952	142.6	1976	141.5	**1982**	168.0	------	117.5
1953	116.6	1996	96.1	**1983**	613.8	------	134.1
1954	56.5	1981	60.3	**1984**	683.1	------	362.6
1955	111.4	1996	95.6	**1985**	369.8	------	180.5
1956	73.7	1981	60.3	**1986**	161.5	------	128.5
1957	388.7	1985	181.1	**1987**	373.6	------	128.1
1958	239.7	1998	175.1	**1988**	168.5	------	105.7
1959	133.3	1976	142.9	**1989**	139.2	------	125.6
1960	205.3	1979	149.9	**1990**	111.3	------	94.7
1961	207.4	1979	150.2	**1991**	102.4	------	84.9
1962	196.1	1979	149.3	**1992**	107.9	------	83.6
1963	61.9	1981	60.1	**1993**	97.5	------	90.1
1964	95.9	1993	89.6	**1994**	103.4	------	93.4
1965	344.4	1999	153.3	**1995**	464.6	------	116.3
1966	91.8	1978	91.1	**1996**	113.5	------	95.7
1967	103.3	1994	93.4	**1997**	166.7	------	101.1
1968	137.6	1989	124.9	**1998**	245.7	------	175.1
1969	387.6	1987	127.9	**1999**	334.6	------	153.2
1970	557.0	1983	134.2	**2000**	121.5	------	103.4
1971	174.1	1982	117.0				

APPENDIX H-B

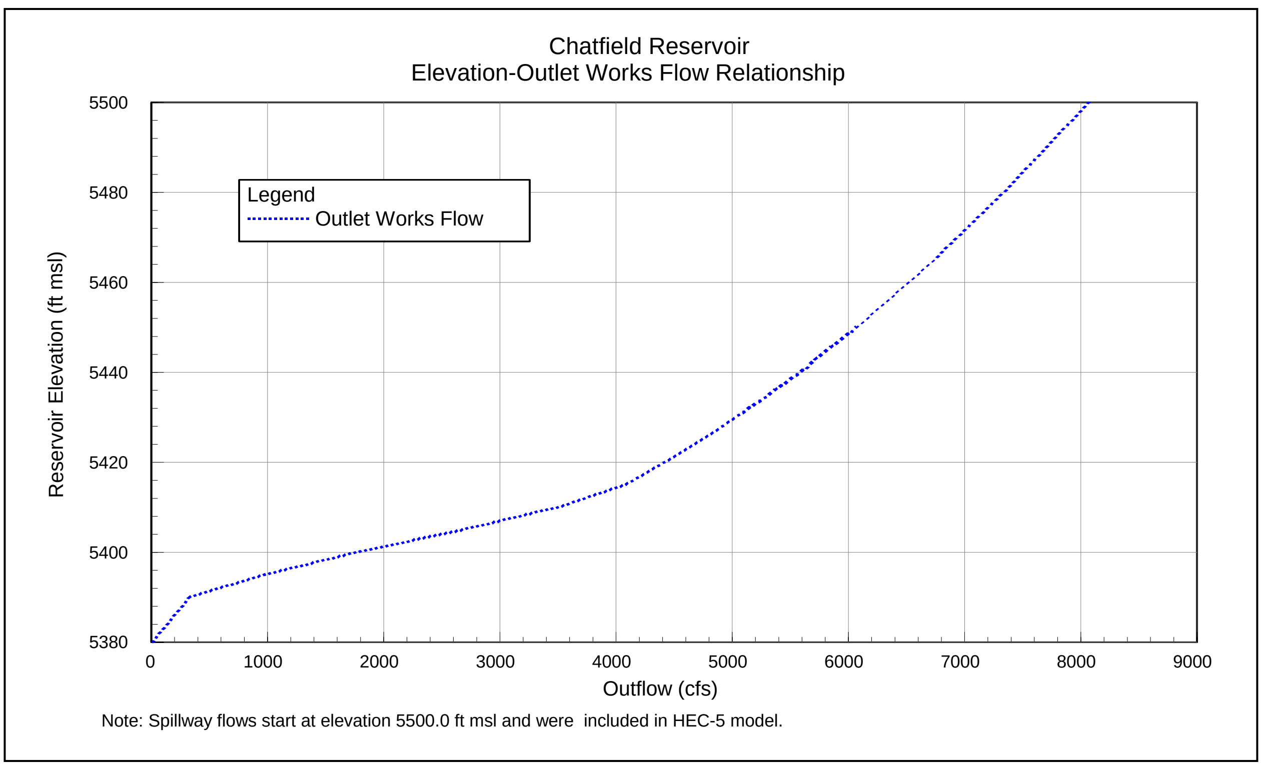
ELEVATION-AREA-CAPACITY-OUTFLOW RELATIONSHIPS
CHATFIELD, BEAR CREEK, AND CHERRY CREEK
RESERVOIRS

STORAGE-OUTFLOW RELATIONSHIPS
THE SOUTH PLATTE RIVER

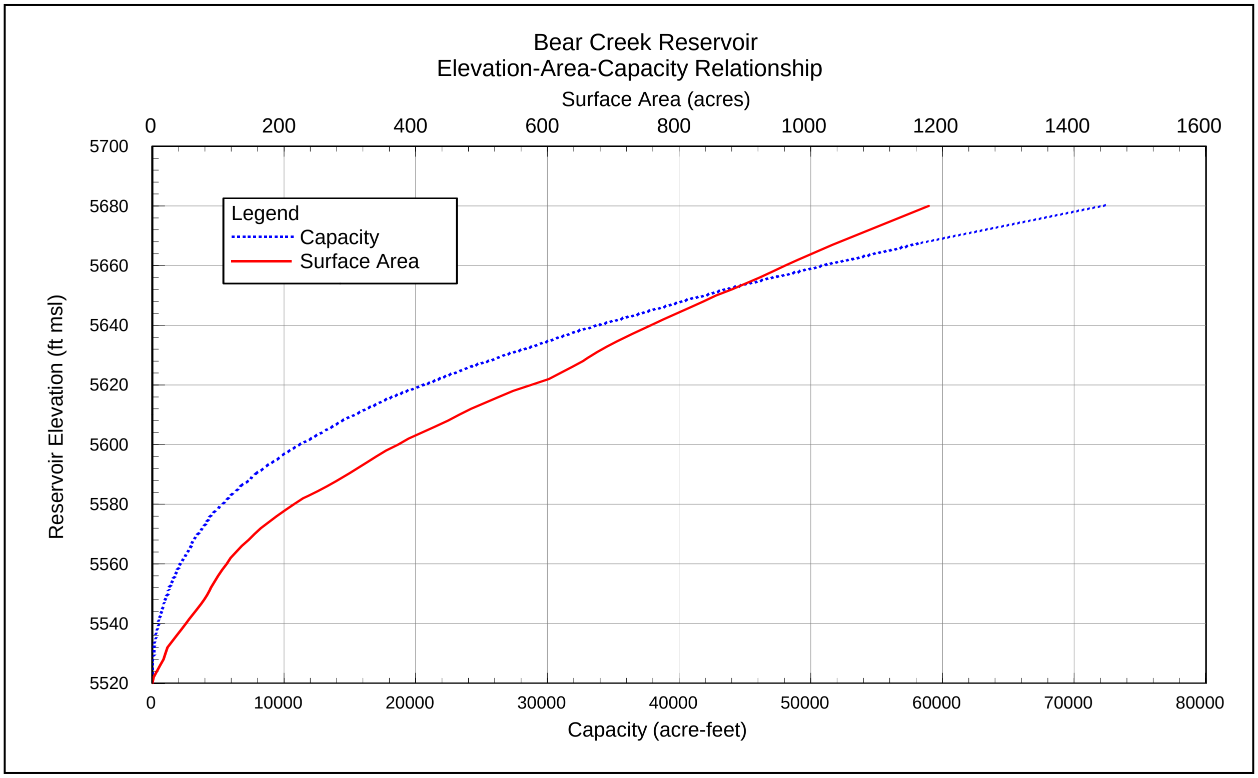
CHATFIELD RESERVOIR
WITH PROJECT CONDITIONS
NEW MONTHLY STORABLE FLOWS AND RELEASES



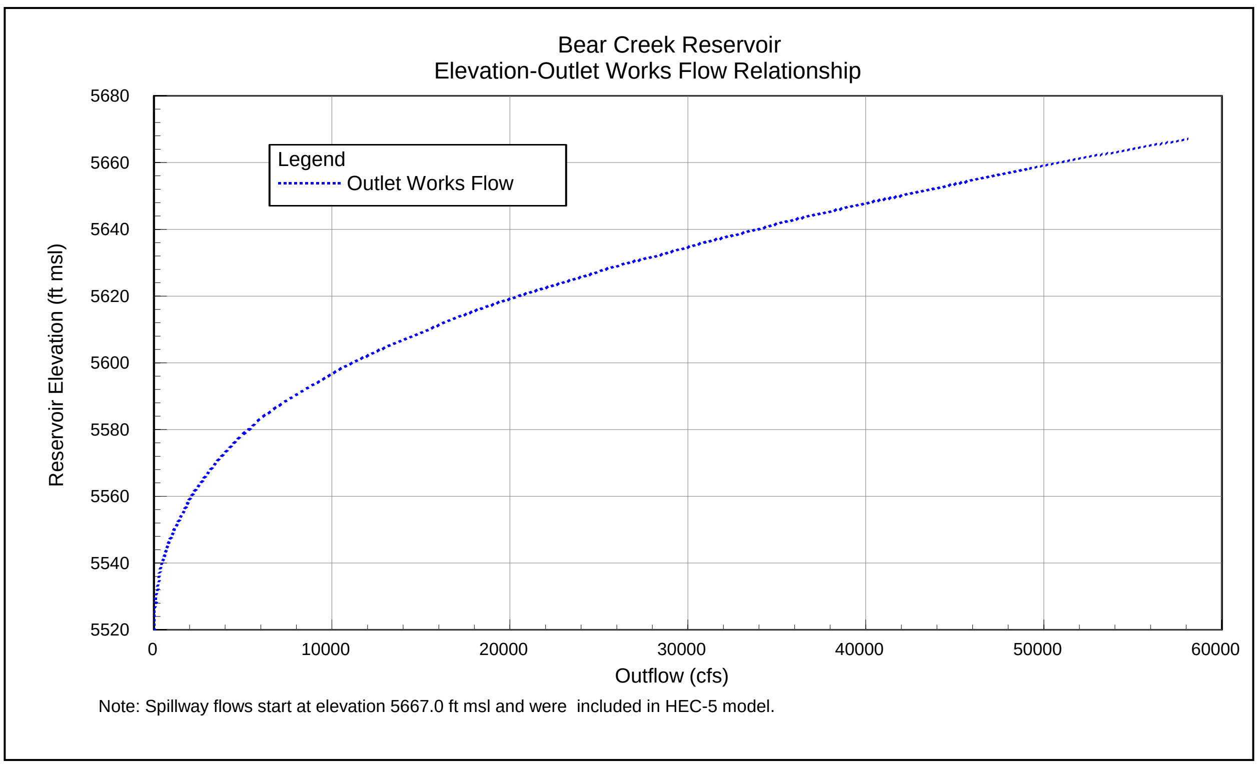
Chatfield Reservoir Elevation-Area-Capacity Relationship



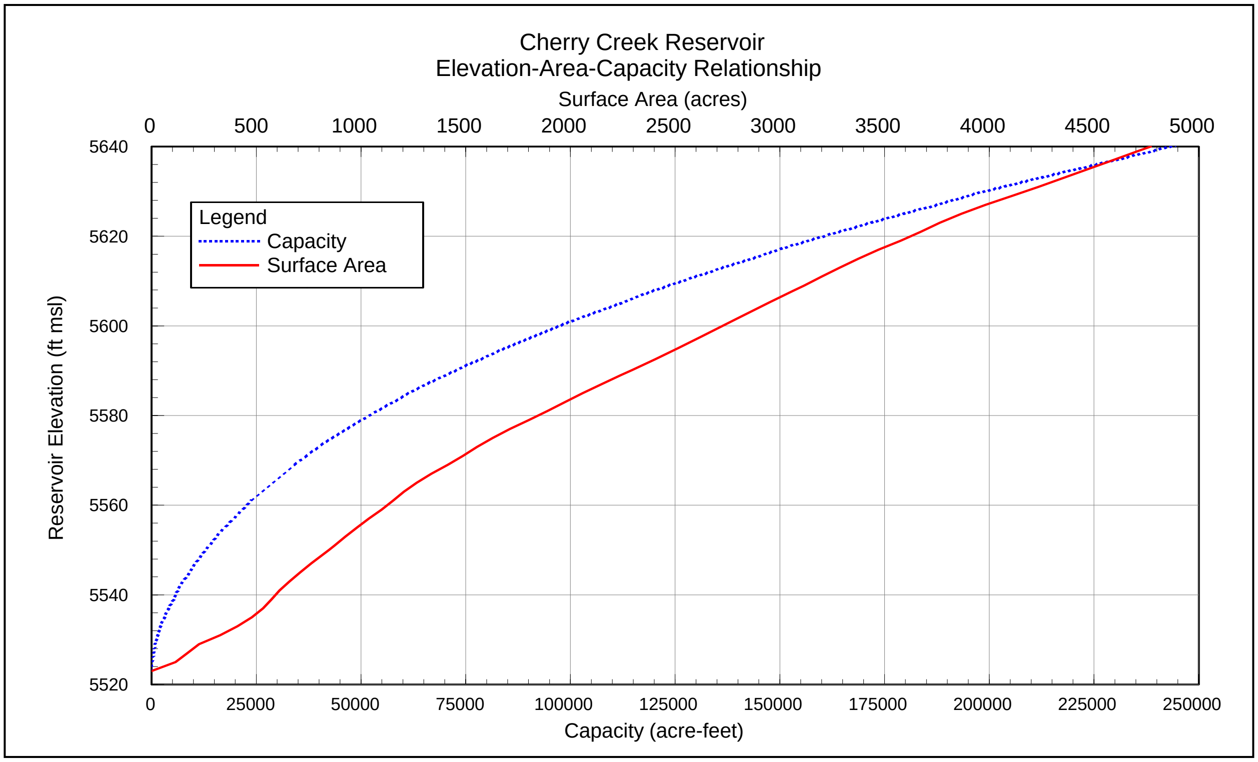
Chatfield Reservoir Elevation-Outwork Works Flow Relationship



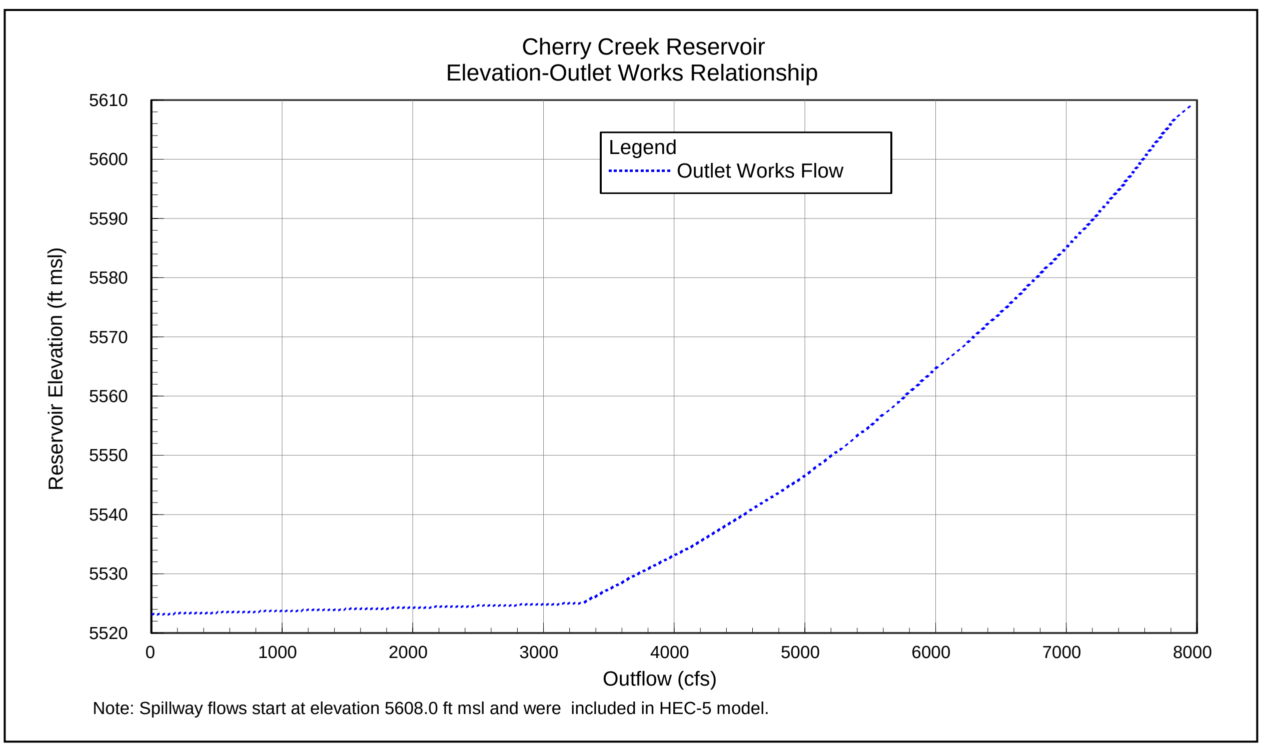
Bear Creek Reservoir Elevation-Area-Capacity Relationship



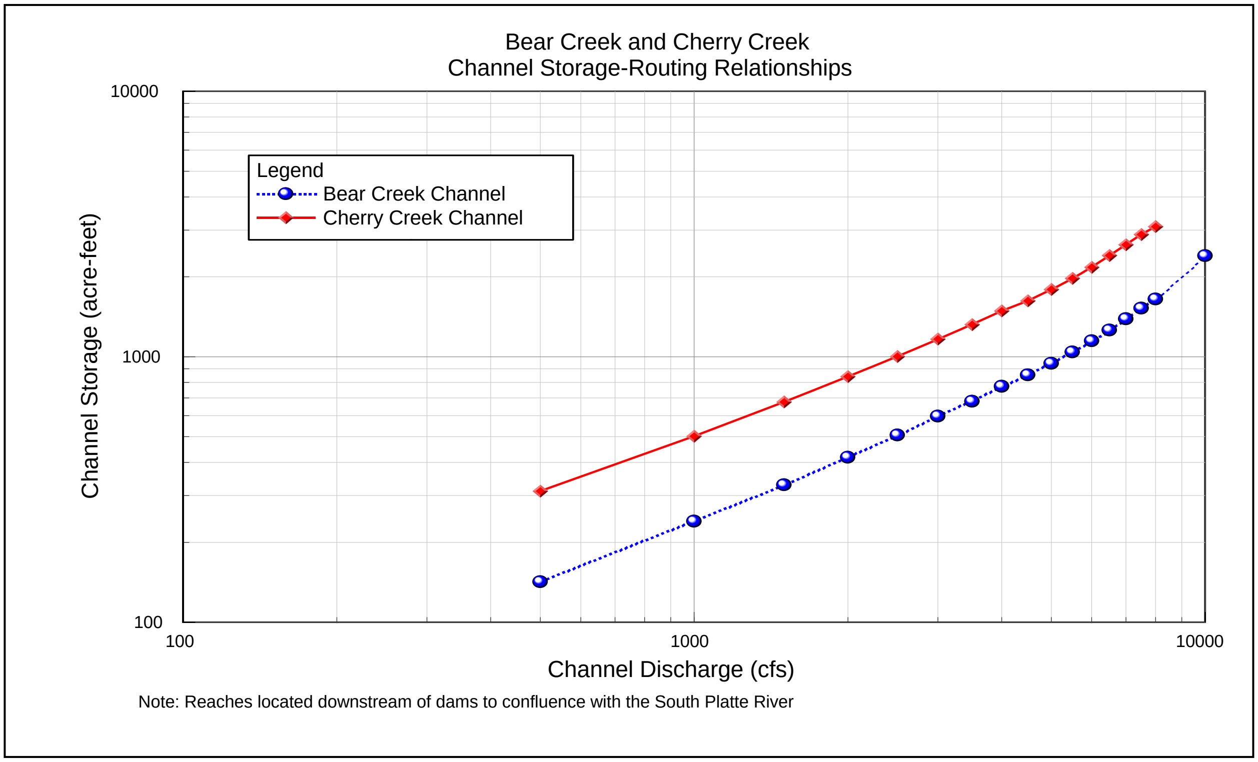
Bear Creek Reservoir Elevation-Outwork Works Flow Relationship



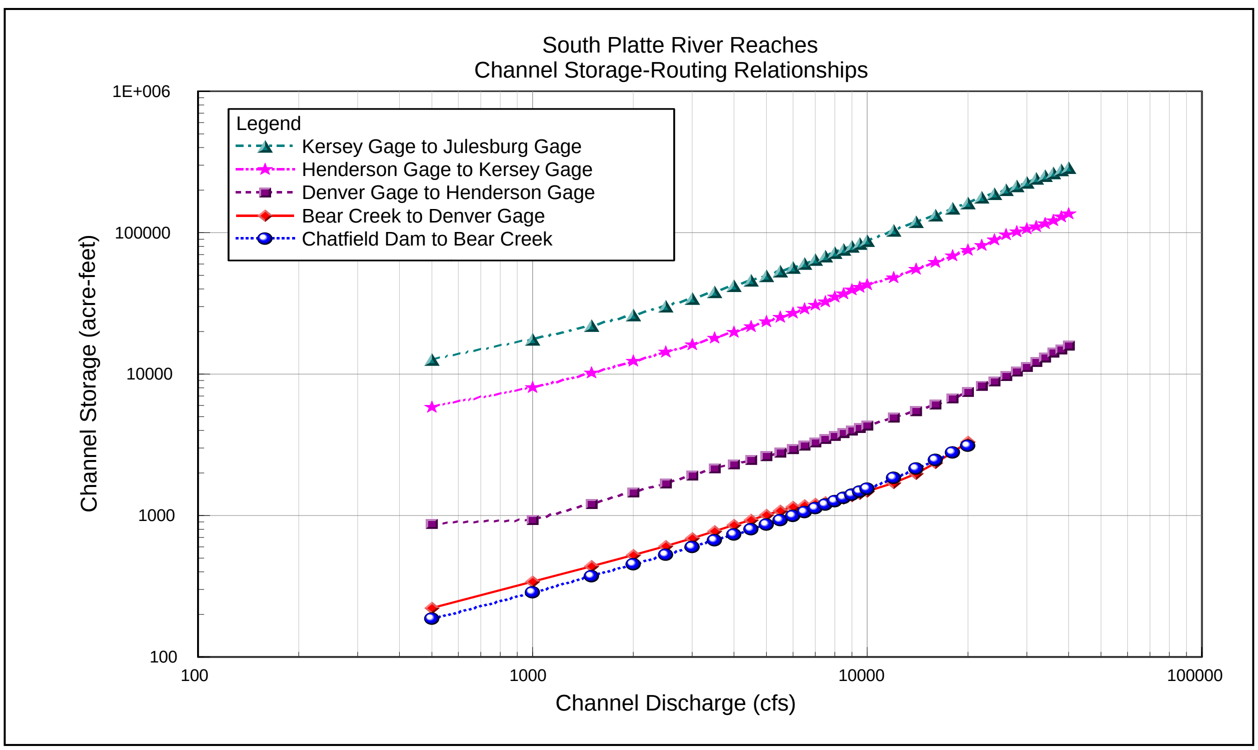
Cherry Creek Reservoir Elevation-Area-Capacity Relationship



Cherry Creek Reservoir Elevation-Outwork Works Flow Relationship



Bear Creek and Cherry Creek Channel Storage-Routing Relationships



South Platte River Reaches Channel Storage-Routing Relationships

Chatfield Reservoir With Project Conditions (5444.0 ft msl Top of Conservation Pool) Average Monthly Storable Inflows to Chatfield Reservoir (cfs)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
1942	0.0	0.0	0.0	179.0	72.7	37.9	38.1	14.3	0.0	0.0	0.0	0.0	28.5
1943	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.02
1944	0.0	0.0	0.0	0.0	0.6	103.3	0.8	0.0	0.0	2.0	0.0	0.0	8.9
1945	0.0	0.0	0.0	0.0	0.7	104.9	0.9	0.0	0.0	0.0	0.0	0.0	8.9
1946	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1947	0.0	0.0	0.0	0.0	82.7	207.3	48.8	0.0	0.0	3.2	0.0	0.0	28.5
1948	0.0	0.0	12.8	144.9	120.7	63.7	0.0	0.0	0.0	0.0	0.0	0.0	28.5
1949	0.0	0.0	0.0	0.0	45.6	241.4	55.1	0.0	0.0	0.0	0.0	0.0	28.5
1950	0.0	0.0	0.0	0.0	7.4	8.5	0.0	0.0	0.0	0.0	0.0	0.0	1.3
1951	0.0	0.0	0.0	0.0	0.0	3.9	0.0	16.4	0.0	0.0	0.0	0.0	1.7
1952	0.0	0.0	0.0	0.0	4.1	14.8	0.0	0.0	0.0	0.0	0.0	0.0	1.6
1953	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.18
1954	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	0.0	0.0	0.0	0.0	23.2	0.0	0.0	2.3	0.0	0.0	0.0	0.0	2.1
1956	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1957	0.0	0.0	0.0	0.0	273.9	44.0	20.7	3.5	0.0	0.0	0.0	0.0	28.5
1958	0.0	0.0	0.0	0.0	222.9	42.1	0.0	0.0	0.0	0.0	0.0	0.0	22.1
1959	0.0	0.0	0.0	0.0	10.7	0.0	0.0	0.0	2.6	0.0	0.0	0.0	1.1
1960	0.0	0.0	2.8	0.0	22.1	0.0	0.4	0.0	0.0	0.0	0.0	0.0	2.1
1961	0.0	0.0	0.0	0.0	23.4	0.0	0.0	0.0	21.0	0.0	0.0	0.0	3.7
1962	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1963	0.0	0.0	0.0	0.0	0.0	15.1	0.0	0.0	0.0	0.0	0.0	0.0	1.3
1964	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1965	0.0	0.0	0.0	0.0	2.9	261.8	23.8	44.3	9.2	0.0	0.0	0.0	28.5
1966	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1967	0.0	0.0	0.0	0.0	5.2	4.8	3.9	0.0	0.0	0.0	0.0	0.0	1.2
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	0.0	0.0	0.0	0.0	305.5	29.8	6.8	0.0	0.0	0.0	0.0	0.0	28.5
1970	0.0	0.0	0.0	89.7	153.2	48.9	48.7	0.0	1.5	0.0	0.0	0.0	28.5
1971	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	26.0	241.9	55.1	17.2	0.0	1.8	0.0	0.0	0.0	28.5
1974	0.0	0.0	8.7	22.5	3.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0	3.0
1975	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.03
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.02
1979	0.0	0.0	0.0	0.0	18.7	87.1	0.8	0.0	0.0	0.0	0.0	0.0	8.9
1980	0.0	0.0	0.0	40.2	236.9	47.2	17.8	0.0	0.0	0.0	0.0	0.0	28.5
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	183.2	55.5	39.5	43.8	20.1	0.0	0.0	0.0	0.0	28.5
1984	0.0	0.0	11.4	135.4	45.2	51.7	19.2	45.2	17.6	5.8	5.3	5.1	28.5
1985	7.8	18.2	38.1	92.3	98.8	62.6	18.2	6.1	0.0	0.0	0.0	0.0	28.5
1986	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.03
1987	0.0	0.0	0.0	190.6	88.2	53.5	9.7	0.0	0.0	0.0	0.0	0.0	28.5
1988	0.0	0.0	0.0	15.7	49.4	0.0	13.4	1.5	0.0	0.0	0.0	0.0	6.7
1989	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.01
1990	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01
1991	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.03
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	8.1	7.8	0.0	0.0	0.0	0.0	0.0	0.0	1.3
1994	0.0	0.0	0.0	0.0	0.0	4.5	0.0	14.0	0.0	1.8	0.0	0.0	1.7
1995	0.0	0.0	8.0	83.6	191.8	58.5	0.0	0.0	0.0	0.0	0.0	0.0	28.5
1996	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1997	0.0	0.0	4.4	10.3	2.4	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6
1998	0.0	0.0	0.0	0.0	212.5	52.4	0.0	0.0	0.0	0.0	0.0	0.0	22.1
1999	0.0	0.0	0.0	0.0	256.9	50.2	26.5	8.4	0.0	0.0	0.0	0.0	28.5
2000	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2

Note: Only includes water available for storage using water rights subject to Colorado's water rights priority system.

Chatfield Reservoir With Project Conditions (5444.0 ft msl Top of Conservation Pool) Average Monthly Flows Diverted from Chatfield Reservoir[1] (cfs)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
1942	0.2	0.2	1.7	1.8	7.0	38.0	36.6	36.6	39.5	34.6	37.4	2.0	19.6
1943	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.4	5.9	1.3	2.1	2.0	3.3
1944	2.0	2.1	1.9	2.0	5.1	4.4	4.3	3.8	22.2	0.4	2.1	2.0	4.3
1945	2.0	2.2	1.9	2.0	4.3	3.6	3.4	3.8	22.2	0.4	2.1	2.0	4.2
1946	2.0	2.2	1.9	2.0	3.5	3.6	3.4	3.8	4.2	0.4	2.1	2.0	2.6
1947	2.0	2.2	1.9	2.0	4.3	3.6	39.6	38.6	41.8	34.6	37.4	2.0	17.5
1948	2.0	2.1	1.9	2.0	18.2	38.0	36.6	5.6	39.5	33.8	37.4	2.0	18.2
1949	2.0	2.2	1.9	25.4	7.6	37.2	39.6	7.7	41.8	34.6	37.4	2.0	19.9
1950	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.4	5.9	1.3	2.1	2.0	3.3
1951	2.0	2.2	1.9	2.0	5.1	4.4	4.3	4.6	5.1	1.3	2.1	2.0	3.1
1952	2.0	2.1	1.9	2.0	13.7	5.2	5.1	5.4	5.9	2.1	2.1	2.0	4.1
1953	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.4	5.9	1.3	2.1	2.0	3.3
1954	2.0	2.2	1.9	2.0	5.1	4.4	4.3	3.8	4.2	0.4	2.0	1.9	2.8
1955	2.0	2.2	1.9	2.0	4.3	3.6	3.4	3.8	4.2	0.4	2.0	1.9	2.6
1956	2.0	2.1	1.9	2.0	4.4	3.6	3.4	3.8	4.2	0.4	2.0	1.9	2.6
1957	2.0	2.2	1.9	2.0	4.3	36.3	35.7	5.6	39.5	34.6	37.4	2.0	17.0
1958	2.0	2.2	1.9	2.0	28.8	5.8	5.7	6.0	40.1	34.6	37.4	2.0	14.0
1959	2.0	2.2	1.9	25.4	14.6	5.8	5.7	6.0	6.5	2.1	2.1	2.0	6.3
1960	2.0	2.1	1.9	2.0	72.2	7.7	5.1	5.4	5.9	2.1	2.1	2.0	9.2
1961	2.0	2.2	1.9	25.3	31.7	7.7	5.1	5.4	5.9	2.1	2.1	2.0	7.8
1962	2.0	2.2	12.1	10.5	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	5.0
1963	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.4
1964	2.0	2.1	1.9	1.1	4.3	4.4	4.3	3.8	4.2	0.4	2.1	2.0	2.7
1965	2.0	2.2	1.9	2.0	4.3	4.3	39.6	17.2	73.7	34.6	37.4	2.0	18.4
1966	2.0	2.2	4.8	2.0	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.7
1967	2.0	2.2	1.9	2.0	5.1	5.2	5.1	4.6	4.2	1.2	2.1	2.0	3.1
1968	2.0	2.1	1.9	1.9	4.3	3.6	3.4	3.8	4.2	0.4	2.1	2.0	2.6
1969	2.0	2.2	1.9	1.9	21.9	50.7	6.2	6.2	40.1	34.6	37.4	11.3	18.0
1970	2.0	2.2	1.9	35.5	17.0	38.6	37.1	37.1	40.1	34.6	37.4	2.0	23.8
1971	2.0	2.2	1.9	15.1	41.9	5.2	5.1	5.4	5.9	2.1	2.1	2.0	7.6
1972	2.0	2.1	1.9	2.0	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.4
1973	2.0	2.2	1.9	36.7	26.0	59.2	38.8	7.2	40.1	34.6	37.4	2.0	24.0
1974	7.7	7.5	25.8	53.3	9.6	5.2	5.1	5.4	5.9	2.1	2.1	2.0	11.0
1975	2.0	2.2	1.9	12.9	6.8	12.6	5.1	5.4	5.9	2.1	2.1	2.0	5.1
1976	2.0	2.1	1.9	2.0	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.4
1977	2.0	2.2	1.9	2.0	5.1	4.9	4.3	4.6	4.2	0.4	2.1	2.0	3.0
1978	2.0	2.2	1.9	1.9	3.5	3.6	3.4	3.8	4.2	0.4	2.0	1.9	2.6
1979	2.0	2.2	1.9	2.0	24.4	5.2	5.1	5.4	24.0	2.1	2.1	2.0	6.5
1980	2.0	2.1	1.9	38.8	19.5	41.2	37.1	6.2	40.1	34.6	37.4	2.0	21.9
1981	2.0	2.2	1.9	2.0	5.1	11.1	5.1	5.4	5.9	2.1	2.1	2.0	3.9
1982	2.0	2.2	1.9	2.0	6.8	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.6
1983	2.0	2.2	14.2	65.2	19.4	54.1	59.7	48.4	40.2	34.6	37.4	2.0	31.6
1984	2.0	2.1	1.9	27.3	50.4	59.7	40.5	11.1	72.8	35.4	38.2	2.8	28.7
1985	2.8	3.1	20.1	25.6	24.4	42.2	37.1	6.4	40.0	34.9	38.2	2.8	23.1
1986	2.0	2.2	9.2	9.4	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	4.6
1987	2.0	2.2	1.9	34.5	24.4	46.3	36.6	5.6	39.5	34.6	39.0	3.6	22.5
1988	3.6	3.9	9.4	31.2	29.8	5.2	5.1	5.4	10.4	2.1	2.1	2.0	9.2
1989	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.4
1990	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.4	5.9	1.9	2.1	2.0	3.4
1991	2.0	2.2	1.9	2.0	5.1	5.2	5.1	5.3	5.1	1.3	2.1	2.0	3.3
1992	2.0	2.1	5.4	2.0	5.1	5.2	5.1	5.4	5.9	2.0	2.1	2.0	3.7
1993	2.0	2.2	1.9	6.8	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.8
1994	2.0	2.2	1.9	8.9	8.3	5.2	5.1	5.4	5.9	2.1	2.1	2.0	4.3
1995	2.0	2.2	1.9	2.0	17.6	57.8	40.9	6.2	40.1	34.6	37.4	2.0	20.4
1996	2.0	2.1	1.9	2.0	5.1	5.2	5.1	5.4	5.9	2.1	2.1	2.0	3.4
1997	2.0	2.2	1.9	2.0	11.8	6.7	5.1	5.4	5.9	2.1	2.9	2.8	4.2
1998	2.8	3.1	12.0	60.0	79.9	8.4	5.7	6.0	40.1	34.6	37.4	2.0	24.3
1999	2.0	2.2	1.9	31.9	21.9	67.0	8.9	9.6	40.1	34.6	37.4	2.0	21.6
2000	2.0	2.1	10.6	7.9	12.2	5.2	5.1	5.4	5.9	2.1	2.1	2.0	5.2

[1] Note: Water users consist of: South Metro Water Supply Authority, Parker Water and Sanitation District, Centennial Water and Sanitation District, Town of Castle Rock, Roxborough Metropolitan District, Castle Pines North Metropolitan District, Castle Pines Metropolitan District, Hock Hocking LLC, Perry Park Country Club, and Center of Colorado Water Conservancy District

Note: Diverted flows include both, Colorado's water rights priority system flows and other inflows not subject to the Colorado water rights priority system, such as non-tributary groundwater.

Chatfield Reservoir
With Project Conditions (5444.0 ft msl Top of Conservation Pool)
Average Monthly Releases Downstream Through Chatfield Reservoir[1] (cfs)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1942	0.0	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.5	7.9
1943	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1944	0.1	0.0	0.0	1.0	2.5	15.2	18.5	19.7	19.8	3.2	0.1	0.7	6.7
1945	0.1	0.0	0.0	1.0	2.5	15.2	18.5	19.7	19.8	3.2	0.1	0.7	6.7
1946	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1947	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
1948	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
1949	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
1950	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1951	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	17.8	0.1	0.1	0.7	6.1
1952	0.1	0.0	0.0	0.0	2.4	15.2	1.5	0.2	0.2	0.1	0.1	0.7	1.7
1953	0.1	0.0	0.0	0.0	0.0	2.1	0.1	0.2	0.2	0.1	0.1	0.7	0.3
1954	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.7	0.1
1955	0.1	0.0	0.0	0.0	2.4	15.2	7.1	1.0	0.2	0.1	0.1	0.7	2.2
1956	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.7	0.1
1957	0.1	0.0	0.0	0.0	2.4	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.8
1958	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
1959	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1960	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	1.2	0.1	0.1	0.7	4.7
1961	0.1	0.0	0.0	0.0	2.4	9.5	0.0	0.2	19.1	3.2	0.1	0.7	2.9
1962	0.1	0.0	0.0	1.0	2.5	9.6	0.1	0.2	0.2	0.1	0.1	0.7	1.2
1963	0.1	0.0	0.0	0.0	0.0	14.7	0.6	0.2	0.2	0.1	0.1	0.7	1.4
1964	0.1	0.0	0.0	0.0	2.4	0.4	0.0	0.2	0.2	0.1	0.1	0.7	0.3
1965	0.1	0.0	0.0	0.0	2.4	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.8
1966	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1967	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	1.5	0.1	0.7	6.4
1968	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.7	0.1
1969	0.1	0.0	0.0	0.0	2.4	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.8
1970	0.1	0.0	0.0	1.0	2.5	15.2	18.5	30.3	23.1	3.2	0.1	0.7	7.9
1971	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1972	0.1	0.0	0.0	1.0	2.5	15.2	17.6	0.2	0.2	0.1	0.1	0.7	3.1
1973	0.1	0.0	0.0	0.2	2.4	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.8
1974	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1975	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	17.9	0.1	0.1	0.7	6.1
1976	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.7	0.1
1977	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.7	0.1
1978	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.1	0.7	0.1
1979	0.1	0.0	0.0	0.1	0.2	14.7	18.5	23.8	19.8	3.2	0.1	0.7	6.8
1980	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
1981	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1982	0.1	0.0	0.0	1.0	2.5	15.2	17.3	0.2	0.2	0.1	0.1	0.7	3.1
1983	0.1	0.0	0.0	1.0	2.5	15.2	18.5	30.3	23.1	3.2	0.1	0.7	7.9
1984	0.1	0.0	0.0	1.0	2.5	15.2	18.5	30.3	23.1	3.2	0.1	0.7	7.9
1985	0.1	0.0	0.0	1.0	2.5	15.2	18.5	30.3	23.1	3.2	0.1	0.7	7.9
1986	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1987	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
1988	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1989	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1990	0.1	0.0	0.0	1.0	2.5	15.2	0.4	0.2	0.2	0.1	0.1	0.7	1.7
1991	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.2	0.1	0.1	0.7	0.1
1992	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.7	0.1
1993	0.1	0.0	0.0	0.0	2.4	13.3	0.3	0.2	0.2	0.1	0.1	0.7	1.4
1994	0.1	0.0	0.0	0.0	0.0	3.0	0.1	16.5	0.7	0.1	0.1	0.7	1.8
1995	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1996	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5
1997	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	0.4	0.1	0.1	0.7	4.6
1998	0.1	0.0	0.0	0.0	2.4	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.8
1999	0.1	0.0	0.0	1.0	2.5	15.2	18.5	27.0	26.5	3.2	0.1	0.7	7.9
2000	0.1	0.0	0.0	1.0	2.5	15.2	18.5	17.3	19.8	3.2	0.1	0.7	6.5

[1] Note: Water users consist of: City of Aurora, City of Brighton, Central Colorado Water Conservancy District, Western Mutual Ditch Company, Colorado Division of Parks and Outdoor Recreation , and Denver Botanic Gardens

Chatfield Reservoir
With Project Conditions (5444.0 ft msl Top of Conservation Pool)
Average Monthly Flows Diverted from South Platte River[1] (cfs)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1942	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1943	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1944	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1945	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1946	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1947	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1948	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1949	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1950	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1951	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	17.7	0.0	0.0	0.0	6.0
1952	0.0	0.0	0.0	0.0	2.4	15.2	1.5	0.0	0.0	0.0	0.0	0.0	1.6
1953	0.0	0.0	0.0	0.0	0.0	2.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2
1954	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	0.0	0.0	0.0	0.0	2.4	15.2	7.1	0.8	0.1	0.0	0.0	0.0	2.1
1956	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1957	0.0	0.0	0.0	0.0	2.4	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1958	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1959	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1960	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	1.0	0.0	0.0	0.0	4.6
1961	0.0	0.0	0.0	0.0	2.4	9.4	0.0	0.0	19.0	3.2	0.0	0.0	2.8
1962	0.0	0.0	0.0	1.0	2.5	9.6	0.1	0.0	0.0	0.0	0.0	0.0	1.1
1963	0.0	0.0	0.0	0.0	0.0	14.7	0.6	0.0	0.0	0.0	0.0	0.0	1.3
1964	0.0	0.0	0.0	0.0	2.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1965	0.0	0.0	0.0	0.0	2.4	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1966	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1967	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	1.4	0.0	0.0	6.3
1968	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1969	0.0	0.0	0.0	0.0	2.4	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1970	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1971	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1972	0.0	0.0	0.0	1.0	2.5	15.2	17.7	0.0	0.0	0.0	0.0	0.0	3.0
1973	0.0	0.0	0.0	0.2	2.4	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1974	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1975	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	17.8	0.0	0.0	0.0	6.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.2	0.2	14.7	18.5	17.1	19.6	3.2	0.0	0.0	6.1
1980	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1981	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1982	0.0	0.0	0.0	1.0	2.5	15.2	17.3	0.0	0.0	0.0	0.0	0.0	3.0
1983	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1984	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1985	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1986	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1987	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1988	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1989	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1990	0.0	0.0	0.0	1.0	2.5	15.2	0.4	0.0	0.0	0.0	0.0	0.0	1.6
1991	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	2.4	13.3	0.3	0.0	0.0	0.0	0.0	0.0	1.3
1994	0.0	0.0	0.0	0.0	0.0	3.0	0.1	16.3	0.6	0.0	0.0	0.0	1.7
1995	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1996	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1997	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	0.3	0.0	0.0	0.0	4.6
1998	0.0	0.0	0.0	0.0	2.4	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
1999	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4
2000	0.0	0.0	0.0	1.0	2.5	15.2	18.5	17.1	19.6	3.2	0.0	0.0	6.4

[1]Note: Water is diverted out of the South Platte River between Hendersen and Kersey gages for the City of Aurora, City of Brighton, Central Colorado Water Conservancy District, and Western Mutual Ditch Company.
Flows are left in-stream and not diverted for Colorado Division of Parks and Outdoor Recreation and Denver Botanic Gardens

APPENDIX H-C

FLOW AND POOL ELEVATION DURATION RELATIONSHIPS

ANNUAL, MONTHLY, AND SEASONAL

CHATFIELD, BEAR CREEK, AND CHERRY CREEK RESERVOIRS AND THE SOUTH PLATTE RIVER

CHATFIELD RESERVOIR ELEVATION DURATION - BASE CONDITIONS (5432.0 FT MSL POOL)

Percent of Time	Reservoir Elevation (ft msl)																
Equalled or Exceeded	**Annual**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**
0.01	5458.5	5432.0	5432.0	5432.0	5451.6	5458.9	5444.9	5432.0	5438.5	5432.0	5432.0	5432.0	5432.0	5432.0	5458.9	5438.5	5432.0
0.05	5455.7	5432.0	5432.0	5432.0	5451.6	5458.9	5444.9	5432.0	5438.5	5432.0	5432.0	5432.0	5432.0	5432.0	5458.3	5435.1	5432.0
0.1	5452.9	5432.0	5432.0	5432.0	5450.4	5458.7	5444.7	5432.0	5435.4	5432.0	5432.0	5432.0	5432.0	5432.0	5457.2	5433.4	5432.0
0.2	5447.9	5432.0	5432.0	5432.0	5448.6	5457.9	5444.1	5432.0	5434.3	5432.0	5432.0	5432.0	5432.0	5432.0	5455.7	5432.1	5432.0
0.5	5434.1	5432.0	5432.0	5432.0	5437.1	5456.1	5442.6	5432.0	5432.1	5432.0	5432.0	5432.0	5432.0	5432.0	5451.3	5432.1	5432.0
1	5432.1	5432.0	5432.0	5432.0	5432.1	5453.8	5438.1	5432.0	5432.1	5432.0	5432.0	5432.0	5432.0	5432.0	5444.5	5432.1	5432.0
2	5432.1	5432.0	5432.0	5432.0	5432.1	5448.5	5432.1	5432.0	5432.1	5432.0	5432.0	5432.0	5432.0	5432.0	5432.9	5432.1	5432.0
5	5432.1	5432.0	5432.0	5432.0	5432.1	5432.1	5432.1	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.1	5432.0	5432.0
10	5432.0	5432.0	5432.0	5432.0	5432.0	5432.1	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.1	5432.0	5432.0
15	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0
20	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5432.0	5431.9	5431.9	5431.9	5432.0	5432.0	5432.0	5432.0	5432.0	5431.9	5432.0
30	5432.0	5431.9	5432.0	5432.0	5432.0	5432.0	5432.0	5431.2	5431.5	5431.3	5431.7	5431.9	5431.8	5432.0	5432.0	5431.4	5431.8
40	5431.5	5431.6	5432.0	5432.0	5432.0	5431.9	5431.9	5430.5	5430.7	5430.2	5430.2	5430.6	5430.4	5431.9	5431.9	5430.5	5430.4
50	5430.5	5430.5	5431.8	5431.9	5431.8	5431.2	5431.4	5429.9	5429.9	5429.1	5429.2	5429.5	5429.7	5431.5	5431.5	5429.7	5429.5
60	5429.6	5429.7	5430.0	5430.5	5430.8	5430.6	5430.8	5429.0	5429.1	5427.9	5428.1	5428.4	5428.9	5430.0	5430.7	5428.6	5428.5
70	5428.4	5428.5	5429.1	5429.5	5430.0	5430.0	5430.2	5427.9	5427.8	5427.2	5427.4	5426.6	5427.6	5429.1	5430.1	5427.6	5427.2
80	5427.0	5426.4	5427.6	5428.5	5428.6	5428.5	5429.2	5426.9	5427.0	5426.4	5425.8	5425.4	5425.3	5427.4	5428.8	5426.8	5425.6
85	5426.3	5424.9	5425.1	5426.2	5427.2	5427.8	5428.7	5426.4	5426.4	5426.0	5424.9	5424.8	5424.5	5425.2	5428.0	5426.4	5424.7
90	5425.3	5424.0	5424.4	5424.7	5425.8	5427.3	5427.8	5426.4	5426.3	5425.4	5424.0	5423.8	5423.9	5424.4	5427.2	5426.3	5423.9
95	5424.0	5423.8	5424.0	5424.1	5424.2	5426.3	5426.9	5426.3	5426.3	5424.9	5423.3	5423.2	5423.0	5423.9	5426.1	5426.0	5423.2
98	5423.3	5423.6	5423.8	5423.8	5423.6	5425.8	5426.4	5426.2	5426.2	5424.4	5423.0	5423.0	5423.0	5423.7	5424.2	5425.0	5423.0
99	5423.0	5423.5	5423.7	5423.7	5423.4	5424.4	5426.4	5426.2	5426.2	5424.2	5423.0	5423.0	5423.0	5423.6	5423.8	5424.6	5423.0
99.5	5423.0	5423.5	5423.7	5423.6	5423.2	5424.0	5426.4	5426.2	5426.1	5424.1	5423.0	5423.0	5423.0	5423.5	5423.5	5424.4	5423.0
99.8	5423.0	5423.4	5423.6	5423.5	5423.1	5423.9	5426.3	5426.2	5426.1	5423.9	5422.9	5422.9	5423.0	5423.4	5423.3	5424.1	5422.9
99.9	5423.0	5423.3	5423.5	5423.4	5423.0	5423.8	5426.3	5426.2	5426.1	5423.9	5422.9	5422.9	5423.0	5423.4	5423.1	5424.0	5422.9
99.95	5422.9	5423.3	5423.5	5423.4	5423.0	5423.8	5426.3	5426.2	5426.1	5423.8	5422.9	5422.9	5423.0	5423.3	5423.0	5423.9	5422.9
99.99	5422.9	5423.2	5423.4	5423.2	5423.0	5423.7	5426.3	5426.2	5426.1	5423.7	5422.9	5422.9	5423.0	5423.2	5423.0	5423.8	5422.9

Note: Based on daily values. Period of Record 1942 through 2000

CHATFIELD RESERVOIR ELEVATION DURATION - WITH PROJECT CONDITIONS (5437.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Reservoir Elevation (ft msl) Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	5458.4	5437.0	5437.0	5437.0	5455.0	5460.1	5454.1	5437.0	5440.3	5437.0	5437.0	5437.0	5437.0	5437.0	5460.1	5440.3	5437.0
0.05	5456.0	5437.0	5437.0	5437.0	5455.0	5460.1	5454.1	5437.0	5440.3	5437.0	5437.0	5437.0	5437.0	5437.0	5458.0	5437.1	5437.0
0.1	5454.3	5437.0	5437.0	5437.0	5454.5	5458.7	5453.6	5437.0	5437.6	5437.0	5437.0	5437.0	5437.0	5437.0	5457.1	5437.1	5437.0
0.2	5451.3	5437.0	5437.0	5437.0	5452.4	5457.7	5451.7	5437.0	5437.1	5437.0	5437.0	5437.0	5437.0	5437.0	5456.0	5437.1	5437.0
0.5	5437.6	5437.0	5437.0	5437.0	5444.0	5456.4	5448.5	5437.0	5437.1	5437.0	5437.0	5437.0	5437.0	5437.0	5453.5	5437.1	5437.0
1	5437.1	5437.0	5437.0	5437.0	5437.1	5454.8	5443.9	5437.0	5437.1	5437.0	5437.0	5437.0	5437.0	5437.0	5449.9	5437.1	5437.0
2	5437.1	5437.0	5437.0	5437.0	5437.1	5451.0	5437.1	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.5	5437.0	5437.0
5	5437.0	5437.0	5437.0	5437.0	5437.1	5437.1	5437.1	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.1	5437.0	5437.0
10	5437.0	5437.0	5437.0	5437.0	5437.0	5437.1	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.1	5437.0	5437.0
15	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5436.9	5436.8	5436.9	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0
20	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5437.0	5436.8	5436.6	5436.4	5436.3	5436.9	5437.0	5437.0	5437.0	5436.6	5436.8
30	5436.7	5436.7	5437.0	5437.0	5437.0	5437.0	5437.0	5436.1	5435.7	5435.4	5435.4	5435.7	5436.2	5437.0	5437.0	5435.7	5435.8
40	5435.8	5435.4	5436.5	5436.9	5436.9	5436.7	5436.8	5435.3	5434.8	5434.2	5434.3	5434.6	5435.0	5436.6	5436.8	5434.8	5434.5
50	5434.6	5434.3	5435.5	5436.4	5436.6	5435.9	5436.3	5434.2	5433.9	5432.8	5433.2	5433.6	5433.7	5435.4	5436.2	5433.7	5433.5
60	5433.5	5433.3	5434.2	5434.9	5435.2	5435.0	5435.5	5433.3	5432.9	5432.1	5432.1	5432.3	5432.4	5434.0	5435.2	5432.8	5432.3
70	5432.1	5431.9	5432.3	5432.8	5433.5	5433.8	5434.2	5432.5	5432.2	5431.3	5431.0	5430.3	5430.9	5432.2	5433.9	5431.9	5430.7
80	5429.7	5426.4	5427.9	5428.7	5430.5	5432.9	5432.9	5429.9	5430.7	5429.7	5428.4	5427.2	5426.4	5428.2	5432.2	5430.0	5427.6
85	5427.1	5425.4	5425.9	5426.4	5427.2	5431.1	5431.4	5427.7	5429.1	5427.4	5426.0	5424.9	5424.7	5425.9	5430.6	5428.0	5425.3
90	5426.0	5424.1	5424.4	5424.8	5426.0	5427.6	5430.1	5426.5	5426.7	5426.1	5424.2	5424.0	5424.0	5424.5	5427.7	5426.4	5424.0
95	5424.1	5423.8	5423.9	5424.0	5424.6	5426.4	5428.1	5426.4	5426.4	5425.0	5423.8	5423.8	5423.8	5423.9	5426.2	5426.2	5423.8
98	5423.7	5423.6	5423.8	5423.8	5423.8	5425.8	5426.5	5426.4	5426.4	5424.2	5423.6	5423.6	5423.6	5423.7	5424.6	5425.3	5423.6
99	5423.6	5423.5	5423.7	5423.6	5423.7	5424.4	5426.4	5426.3	5426.3	5424.0	5423.4	5423.5	5423.5	5423.6	5423.9	5424.5	5423.4
99.5	5423.4	5423.4	5423.6	5423.5	5423.5	5423.9	5426.4	5426.3	5426.3	5423.8	5423.3	5423.4	5423.4	5423.5	5423.7	5424.1	5423.3
99.8	5423.3	5423.3	5423.5	5423.4	5423.4	5423.8	5426.3	5426.3	5426.3	5423.7	5423.2	5423.2	5423.3	5423.3	5423.5	5423.9	5423.2
99.9	5423.2	5423.2	5423.5	5423.3	5423.3	5423.7	5426.3	5426.3	5426.2	5423.6	5423.1	5423.2	5423.2	5423.3	5423.4	5423.7	5423.1
99.95	5423.1	5423.2	5423.5	5423.2	5423.2	5423.6	5426.3	5426.3	5426.2	5423.5	5423.1	5423.1	5423.2	5423.2	5423.3	5423.6	5423.1
99.99	5423.0	5423.1	5423.4	5423.1	5423.1	5423.5	5426.3	5426.2	5426.2	5423.4	5422.9	5423.0	5423.1	5423.1	5423.2	5423.4	5423.0

Note: Based on daily values. Period of Record 1942 through 2000

CHATFIELD RESERVOIR ELEVATION DURATION - WITH PROJECT CONDITIONS (5444.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Reservoir Elevation (ft msl)															
	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	5465.3	5444.0	5444.0	5444.0	5459.9	5465.7	5458.7	5444.0	5444.3	5444.0	5444.0	5444.0	5444.0	5444.0	5465.7	5444.3	5444.0
0.05	5461.8	5444.0	5444.0	5444.0	5459.9	5465.7	5458.7	5444.0	5444.3	5444.0	5444.0	5444.0	5444.0	5444.0	5465.1	5444.1	5444.0
0.1	5459.4	5444.0	5444.0	5444.0	5459.3	5465.5	5458.4	5444.0	5444.1	5444.0	5444.0	5444.0	5444.0	5444.0	5463.9	5444.1	5444.0
0.2	5456.5	5444.0	5444.0	5444.0	5457.4	5464.7	5457.2	5444.0	5444.1	5444.0	5444.0	5444.0	5444.0	5444.0	5461.8	5444.1	5444.0
0.5	5444.6	5444.0	5444.0	5444.0	5449.0	5462.5	5454.7	5444.0	5444.1	5444.0	5444.0	5444.0	5444.0	5444.0	5458.6	5444.1	5444.0
1	5444.1	5444.0	5444.0	5444.0	5444.1	5459.9	5450.1	5444.0	5444.1	5444.0	5444.0	5444.0	5444.0	5444.0	5455.2	5444.0	5444.0
2	5444.1	5444.0	5444.0	5444.0	5444.1	5456.0	5444.1	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5444.6	5444.0	5444.0
5	5444.0	5444.0	5444.0	5444.0	5444.1	5444.1	5444.1	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5444.1	5444.0	5444.0
10	5444.0	5444.0	5444.0	5444.0	5444.0	5444.1	5444.0	5444.0	5444.0	5443.8	5443.9	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0
15	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5444.0	5443.7	5443.1	5443.0	5443.9	5443.9	5444.0	5444.0	5443.7	5443.8
20	5443.8	5443.9	5444.0	5444.0	5444.0	5444.0	5444.0	5443.7	5443.3	5442.1	5441.8	5442.5	5443.3	5444.0	5444.0	5443.2	5442.5
30	5442.7	5442.4	5442.9	5443.4	5443.7	5443.8	5444.0	5442.7	5442.2	5440.9	5440.7	5440.7	5440.8	5443.0	5443.8	5442.0	5440.7
40	5441.2	5440.5	5441.2	5442.2	5442.9	5442.9	5443.4	5441.7	5441.0	5439.2	5439.1	5439.2	5439.6	5441.3	5443.1	5440.8	5439.3
50	5439.9	5439.0	5440.2	5441.0	5442.1	5441.6	5442.6	5440.7	5439.8	5438.4	5437.8	5438.0	5438.1	5440.2	5442.2	5439.5	5438.0
60	5438.3	5437.0	5438.1	5439.2	5439.8	5440.7	5441.4	5439.7	5438.7	5437.6	5437.0	5436.5	5436.7	5438.0	5440.9	5438.4	5436.8
70	5436.5	5435.1	5436.5	5436.5	5437.2	5439.2	5440.3	5438.1	5436.9	5436.2	5435.3	5434.9	5434.6	5436.0	5439.0	5437.0	5434.9
80	5432.9	5429.4	5429.7	5429.2	5434.0	5435.6	5438.5	5435.4	5433.6	5433.2	5431.4	5430.5	5428.9	5429.4	5435.5	5433.8	5430.6
85	5429.1	5427.7	5427.9	5428.3	5428.0	5431.7	5431.9	5431.7	5432.1	5430.8	5428.4	5427.5	5427.5	5428.0	5430.7	5431.5	5427.7
90	5427.3	5425.4	5426.3	5427.0	5426.7	5428.6	5429.5	5427.1	5430.2	5428.9	5426.9	5426.6	5426.0	5426.3	5428.1	5429.1	5426.6
95	5425.5	5424.7	5424.7	5424.7	5425.3	5426.7	5428.0	5426.8	5427.5	5426.6	5425.0	5424.7	5424.7	5424.7	5426.6	5426.7	5424.8
98	5424.6	5424.3	5424.4	5424.3	5424.7	5426.2	5426.9	5426.7	5426.8	5425.0	5424.5	5424.2	5424.3	5424.3	5425.5	5426.3	5424.3
99	5424.3	5424.1	5424.2	5424.1	5424.5	5425.8	5426.8	5426.6	5426.7	5424.6	5424.2	5424.0	5424.1	5424.1	5424.9	5425.8	5424.1
99.5	5424.0	5423.9	5424.0	5423.9	5424.2	5425.1	5426.7	5426.5	5426.6	5424.4	5424.0	5423.8	5423.9	5423.9	5424.6	5424.8	5423.9
99.8	5423.8	5423.7	5423.9	5423.7	5424.0	5424.8	5426.6	5426.4	5426.5	5424.1	5423.8	5423.6	5423.7	5423.7	5424.2	5424.4	5423.7
99.9	5423.6	5423.6	5423.8	5423.6	5423.8	5424.7	5426.5	5426.4	5426.4	5423.9	5423.6	5423.5	5423.6	5423.6	5424.0	5424.2	5423.5
99.95	5423.5	5423.5	5423.7	5423.5	5423.7	5424.6	5426.5	5426.3	5426.4	5423.7	5423.5	5423.4	5423.5	5423.5	5423.9	5424.0	5423.4
99.99	5423.2	5423.3	5423.5	5423.3	5423.4	5424.4	5426.4	5426.3	5426.2	5423.4	5423.2	5423.2	5423.3	5423.3	5423.5	5423.6	5423.2

Note: Based on daily values. Period of Record 1942 through 2000

CHATFIELD RESERVOIR OUTFLOW DURATION - BASE CONDITIONS (5432.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Reservoir Outflow (cfs) Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	5000	303	438	901	5000	5000	5000	3385	5000	1543	1326	1003	436	901	5000	5000	1326
0.05	5000	303	438	901	5000	5000	5000	3385	5000	1543	1326	1003	436	628	5000	3349	1198
0.1	5000	264	340	714	5000	5000	5000	3246	3573	1532	1169	1003	323	516	5000	3052	1044
0.2	4496	213	309	564	5000	5000	5000	2820	2879	1455	971	1001	304	425	5000	2616	949
0.5	2799	173	228	423	3545	5000	4971	2247	2389	912	865	903	283	326	5000	2079	776
1	2259	160	188	348	2327	4996	3557	1993	1533	590	747	605	255	252	3772	1626	527
2	1741	135	138	279	1733	3387	2619	1608	1129	487	408	424	221	196	2729	1264	342
5	958	101	114	191	849	2441	2024	1190	792	346	275	279	173	134	2027	846	242
10	508	86	94	139	507	1874	1601	848	624	253	191	174	130	107	1448	609	162
15	354	76	80	116	391	1428	1311	687	531	205	131	135	104	89	1021	501	124
20	271	69	73	103	309	1091	1047	575	473	176	100	119	88	79	705	423	102
30	175	58	61	79	214	467	619	446	352	127	76	87	70	66	387	300	78
40	117	46	54	68	161	333	385	353	263	90	64	73	57	57	287	224	64
50	83	35	48	57	122	255	299	282	207	73	56	59	40	49	221	174	53
60	64	25	42	52	98	202	244	226	167	65	49	46	26	41	169	135	44
70	51	15	34	45	69	154	191	178	136	58	44	28	14	32	121	95	32
80	37	7	11	35	51	108	140	137	103	51	39	21	11	11	85	69	21
85	25	5.3	5	15	42	91	105	114	87	47	35	15	9.2	7	64	61	14
90	11	3.6	2.5	5.8	17	71	79	93	71	42	30	11	5.5	3.3	47	52	11
95	2.4	1.0	0.9	0.8	0.8	36	24	68	47	36	24	5.8	2.6	0.9	1	41	4.9
98	0.8	0.7	0.7	0.7	0.7	1	0.8	18	1.0	23	12.5	1.0	1.0	0.7	0.7	15	1.1
99	0.7	0.6	0.6	0.6	0.6	0.7	0.6	0.8	0.8	0.9	0.9	0.8	0.8	0.6	0.6	0.8	0.8
99.5	0.6	0.5	0.5	0.5	0.5	0.6	0.5	0.7	0.7	0.7	0.8	0.7	0.7	0.5	0.5	0.7	0.7
99.8	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.5	0.6	0.6	0.5	0.5	0.4	0.4	0.5	0.5
99.9	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.5	0.3	0.4	0.4	0.5
99.95	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.4
99.99	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.3

Note: Based on daily values. Period of Record 1942 through 2000

CHATFIELD RESERVOIR OUTFLOW DURATION - WITH PROJECT CONDITIONS (5437.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Reservoir Outflow (cfs)																
	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	5000	303	437	609	5000	5000	5000	3368	4986	1541	1312	1003	436	609	5000	4986	1312
0.05	5000	303	437	609	5000	5000	5000	3368	4986	1541	1312	1003	436	510	5000	3171	1196
0.1	5000	243	340	524	5000	5000	5000	3236	3044	1530	1172	1003	323	453	5000	2964	1047
0.2	4289	191	309	436	5000	5000	5000	2822	2774	1456	956	1001	304	395	5000	2561	930
0.5	2849	172	228	399	3151	5000	5000	2236	2113	912	833	878	283	315	5000	1997	758
1	2240	154	188	333	2339	4907	3621	1965	1587	588	731	588	253	241	3739	1616	507
2	1721	133	136	268	1739	3513	2606	1592	1113	469	404	421	221	190	2779	1269	332
5	942	101	111	184	832	2435	2004	1188	774	326	270	274	172	131	2016	844	234
10	505	84	83	133	491	1860	1584	858	614	238	181	164	125	103	1429	616	157
15	349	74	74	113	369	1418	1278	705	523	198	122	129	102	85	1004	509	117
20	266	65	66	99	295	1081	1026	598	466	162	98	109	87	75	681	429	98
30	170	56	56	76	203	440	607	468	345	112	72	81	70	61	373	302	74
40	113	43	48	64	154	317	383	367	257	89	62	64	55	53	278	226	61
50	80	33	42	56	118	245	298	292	207	76	55	52	39	45	211	173	51
60	62	22	33	49	95	188	242	234	167	68	49	34	26	35	161	135	41
70	48	11	11	42	64	142	189	186	140	62	44	23	15	20	116	96	29
80	32	6.3	3.5	27.7	49	100	136	144	106	55	38	16	10	7.0	80	72	20
85	20	4.6	2.2	8.0	38	81	104	120	90	51	34	12	8.4	3.9	59	64	13
90	8.7	3.2	1.0	1.0	7.2	59	77	94	75	45	28	7.8	4.2	1.1	43	56	9.2
95	1.5	0.9	0.8	0.8	0.8	20	8	65	55	38	23	3.5	2.0	0.8	4.2	43	3.3
98	0.8	0.7	0.6	0.6	0.6	0.8	5.7	12	10	10	4.3	0.8	0.9	0.6	0.8	11	0.9
99	0.7	0.6	0.5	0.5	0.5	0.7	4.2	7	8	8	0.9	0.7	0.8	0.5	0.6	8	0.7
99.5	0.6	0.5	0.4	0.5	0.5	0.5	0.8	6.1	6	8	0.8	0.6	0.7	0.5	0.5	6	0.6
99.8	0.4	0.4	0.4	0.4	0.4	0.4	0.6	1.0	1.0	7.8	0.6	0.5	0.6	0.4	0.4	4.9	0.5
99.9	0.4	0.4	0.3	0.3	0.3	0.4	0.5	0.8	0.8	7.7	0.5	0.4	0.6	0.3	0.4	0.9	0.4
99.95	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.6	0.6	7.7	0.4	0.3	0.5	0.3	0.3	0.7	0.4
99.99	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.4	7.6	0.3	0.2	0.4	0.2	0.2	0.4	0.3

Note: Based on daily values. Period of Record 1942 through 2000

CHATFIELD RESERVOIR OUTFLOW DURATION - WITH PROJECT CONDITIONS (5444.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Reservoir Outflow (cfs) Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	5000	303	436	608	5000	5000	5000	3340	3027	1555	1289	1003	437	608	5000	3340	1289
0.05	5000	303	436	608	5000	5000	5000	3340	3027	1555	1289	1003	437	510	5000	3134	1168
0.1	5000	243	340	524	5000	5000	5000	3220	2806	1516	1035	1003	323	448	5000	2877	1019
0.2	4734	191	309	435	5000	5000	5000	2824	2673	1347	881	1001	303	385	5000	2507	889
0.5	2763	170	228	390	3151	5000	5000	2237	1898	963	824	858	279	308	5000	1954	764
1	2208	152	188	327	2339	5000	3385	1965	1524	586	734	562	252	241	3772	1584	497
2	1700	131	133	263	1745	3474	2512	1582	1017	438	371	387	219	184	2693	1234	320
5	910	99	109	176	791	2393	1976	1164	765	303	227	272	170	128	1999	829	211
10	488	83	81	128	447	1848	1558	844	615	231	138	157	125	99	1404	618	139
15	342	73	70	106	352	1387	1229	703	521	190	108	124	99	81	969	506	110
20	262	62	64	91	281	1033	1003	596	463	160	91	105	84	72	617	430	93
30	165	51	53	71	191	415	560	473	347	114	73	81	65	57	356	306	73
40	109	36	44	57	143	293	366	382	272	95	63	65	47	48	264	233	60
50	79	27	37	51	109	227	291	303	219	85	56	50	31	39	197	177	50
60	60	18	21	43	74	171	235	244	176	77	50	30	20	25	150	140	39
70	44	9.9	6.8	17	53	127	182	190	151	69	45	21	12	10.2	107	100	26
80	23	5.0	2.2	1.0	6.0	91	121	146	117	62	38	12	8.5	3.3	64	80	14
85	11.6	3.5	1.0	0.9	1.0	72	101	120	99	56	34	9.2	5.1	1.0	47	70	10.7
90	4.4	2.1	0.8	0.8	0.9	44	71	92	83	46	28	5.3	2.5	0.9	13.2	61	6.4
95	0.9	0.8	0.7	0.7	0.7	1.3	15	58	52	33	22	0.9	1.0	0.7	0.9	41	1.0
98	0.7	0.7	0.6	0.5	0.6	0.8	14	21	26	23	6.7	0.7	0.9	0.6	0.7	22	0.8
99	0.6	0.6	0.5	0.4	0.5	0.7	12	15	18	19.2	0.9	0.6	0.9	0.5	0.6	17	0.6
99.5	0.5	0.5	0.4	0.4	0.4	0.6	0.9	14	1	18.7	0.7	0.5	0.8	0.4	0.5	13.7	0.5
99.8	0.4	0.4	0.3	0.3	0.3	0.4	0.7	1.0	0.7	0.9	0.6	0.4	0.8	0.3	0.4	0.8	0.4
99.9	0.3	0.4	0.3	0.3	0.3	0.4	0.6	0.8	0.6	0.7	0.5	0.4	0.8	0.3	0.3	0.7	0.4
99.95	0.3	0.3	0.3	0.2	0.3	0.3	0.5	0.6	0.5	0.6	0.4	0.3	0.8	0.3	0.3	0.5	0.3
99.99	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.4	0.3	0.5	0.3	0.2	0.7	0.2	0.2	0.3	0.2

Note: Based on daily values. Period of Record 1942 through 2000

SOUTH PLATTE RIVER AT DENVER GAGE FLOW DURATION - BASE CONDITIONS (5432.0 FT MSL POOL)

Percent of Time	Flow (cfs)																
Equalled or Exceeded	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	8668	1041	1238	2335	6731	14115	9174	4255	8790	2063	4257	1512	600	2335	14115	8790	4257
0.05	6775	1041	1238	2335	6731	14115	9174	4255	8790	2063	4257	1512	600	1889	8339	7002	2162
0.1	6188	762	1114	2043	6624	8780	8909	4166	8091	1765	3145	1370	556	1644	7450	5169	1680
0.2	5575	563	888	1775	6214	7635	7963	3907	6213	1592	1857	1277	528	1403	6749	4333	1433
0.5	4507	426	628	1450	5275	6518	6150	3149	4374	1329	1442	1133	493	1076	5949	3296	1145
1	3575	366	476	1196	3670	5825	4950	2634	3408	1107	1158	761	439	729	5258	2510	856
2	2589	316	380	815	2624	5052	4071	2148	2252	855	892	636	393	548	4392	1864	611
5	1467	258	286	547	1378	3948	2983	1621	1309	613	529	464	329	385	3058	1293	437
10	844	221	243	416	957	2838	2230	1243	956	465	384	375	264	284	2112	926	331
15	595	202	217	341	720	2225	1805	991	779	378	299	304	233	239	1558	733	275
20	474	186	201	292	600	1719	1470	861	674	328	256	264	209	213	1169	623	241
30	332	163	179	220	432	953	987	648	537	255	204	224	179	182	712	473	201
40	248	145	161	181	337	608	671	511	436	213	175	193	158	161	509	369	175
50	198	129	144	157	265	471	501	422	348	184	149	172	145	143	400	292	154
60	165	113	126	139	201	374	406	338	275	157	132	153	133	125	323	236	138
70	139	100	112	116	154	299	330	275	224	135	116	136	120	108	246	188	123
80	115	83	97	96	112	215	252	216	177	110	102	120	106	92	174	149	109
85	103	71	88	85	91	181	217	183	154	98	93	112	98.8	81.1	145	129	100
90	88	61	76	71	69	145	164	148	124	83	80	100	89	67	112	108	88
95	67	48	56	49	25	107	116	114	97	70	69	79	70	51	75	84	72
98	44	37	41	26	15	57	87	91	65	59	55	62	48	35	23	65	54
99	28	31	33	18	12	20	69	76	44	49	48	50	35	25	15	52	43
99.5	18	26	25	14	10	12	52	62	29	47	46	29	28	19	12	41	33
99.8	13	22	17	11	9	9	18	48	21	44	43	18	23	14	10	29	22
99.9	11	20	11	10	9	8	12	28	19	43	41	17	21	11	8	22	19
99.95	9	19	10	9	9	7	10	20	18	41	40	16	20	10	7	19	18
99.99	7	18	10	8	8	5	10	19	16	39	37	14	18	8	5	16	15

Note: Based on daily values. Period of Record 1942 through 2000

SOUTH PLATTE RIVER AT DENVER GAGE FLOW DURATION - WITH PROJECT CONDITIONS (5437.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Flow (cfs)																
	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	8679	1038	1237	2333	6309	14113	6567	4199	8790	2057	4231	1491	598	2333	14113	8790	4231
0.05	6803	1038	1237	2333	6309	14113	6567	4199	8790	2057	4231	1491	598	1889	8361	6599	2169
0.1	6220	762	1114	2043	6242	8780	6496	4091	7886	1787	3201	1471	555	1640	7486	4902	1600
0.2	5609	563	888	1773	5973	7635	6224	3743	5722	1630	1838	1386	528	1415	6795	4296	1379
0.5	4527	432	628	1456	5302	6518	5620	3119	4307	1388	1393	1150	492	1034	6006	3249	1165
1	3557	361	469	1220	3433	5825	5059	2663	3380	1053	1151	769	438	716	5317	2457	853
2	2563	312	382	794	2705	5052	4251	2154	2036	856	883	618	397	543	4414	1834	603
5	1440	255	273	542	1333	3953	2939	1612	1271	585	527	451	329	378	3032	1276	427
10	836	217	229	410	950	2833	2227	1237	935	449	377	352	261	276	2114	926	323
15	589	199	207	335	709	2189	1819	1015	765	373	290	293	230	229	1546	736	268
20	471	183	192	286	576	1712	1446	865	662	325	251	253	209	207	1146	624	237
30	329	160	171	213	422	921	990	661	531	257	199	216	177	177	700	478	197
40	245	142	155	178	327	592	661	532	437	213	169	187	157	157	503	371	171
50	195	127	135	156	257	459	500	437	352	182	148	166	143	138	396	298	152
60	162	112	118	134	197	367	407	347	281	157	130	151	130	120	318	238	136
70	137	98	106	113	152	291	333	286	228	135	115	134	119	105	242	191	122
80	113	82	92	93	111	207	253	225	182	112	102	117	106	89	170	151	107
85	101	71	83	83	91	172	215	192	159	101	93	107	98	79	143	132	99
90	87	61	72	70	69	142	164	155	132	85	81	92	89	66	112	111	87
95	67	48	55	49	26	102	118	118	100	71	71	74	71	50	75	87	72
98	44	37	41	26	15	49	89	93	74	61	57	58	52	35	24	67	55
99	30	31	33	18	12	20	67	71	52	49	49	42	41	26	16	53	45
99.5	18	27	25	14	10	12	52	47	40	46	47	24	32	19	12	43	35
99.8	13	22	17	11	10	9	22	37	31	43	44	19	25	14	10	35	23
99.9	11	20	11	10	10	8	14	32	29	41	42	18	22	11	8	31	19
99.95	9	19	10	9	9	7	10	30	27	39	40	17	20	10	7	29	18
99.99	7	18	10	8	9	5	7	28	25	36	38	16	18	8	5	26	16

Note: Based on daily values. Period of Record 1942 through 2000

SOUTH PLATTE RIVER AT DENVER GAGE FLOW DURATION - WITH PROJECT CONDITIONS (5444.0 FT MSL POOL)

Percent of Time	Flow (cfs)																
Equalled or Exceeded	**Annual**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**
0.01	8664	1033	1236	2331	6309	14174	6320	4212	8790	2051	4073	1456	596	2331	14174	8790	4073
0.05	6776	1033	1236	2331	6309	14174	6320	4212	8790	2051	4073	1456	596	1890	8362	4741	2173
0.1	6190	762	1113	2043	6242	8809	6250	4040	5271	1767	3148	1438	556	1646	7490	4375	1606
0.2	5569	563	888	1777	5973	7696	5991	3654	4523	1595	1839	1359	525	1411	6801	4011	1352
0.5	4476	419	628	1452	5302	6607	5427	2992	3988	1298	1378	1140	490	1068	6012	3068	1100
1	3500	358	476	1231	3607	5926	4923	2558	3127	1052	1094	755	442	711	5320	2396	817
2	2524	308	380	794	2541	5156	4153	2129	2084	825	838	606	394	536	4404	1814	581
5	1407	252	270	534	1337	3942	2926	1577	1275	566	490	443	323	368	2998	1259	414
10	813	214	226	395	923	2796	2157	1218	934	441	340	341	254	266	2073	925	310
15	582	192	202	322	673	2189	1717	1014	759	370	277	290	223	223	1481	733	261
20	464	176	188	269	544	1670	1403	860	665	322	245	252	203	199	1093	623	232
30	326	154	165	202	400	885	908	665	540	260	199	215	173	170	665	480	195
40	242	137	145	171	305	576	641	543	446	219	170	184	154	149	488	379	168
50	193	123	130	147	240	441	495	444	361	189	149	164	140	132	388	304	150
60	159	110	115	126	182	358	409	355	293	165	132	148	128	116	306	245	135
70	135	97	103	108	144	279	338	295	238	143	117	132	117	102	230	200	121
80	112	82	91	89	102	196	255	230	194	119	103	114	104	87	162	159	106
85	100	71	81	77	84	161	214	196	171	106	93	104	96	76	135	140	97
90	85	61	70	63	61	135	163	154	145	89	80	88	87	64	106	118	85
95	64	48	54	45	24	96	122	116	116	72	69	72	68	49	67	91	70
98	42	37	41	25	15	40	93	83	88	61	52	57	51	35	22	68	53
99	28	31	33	18	12	17	74	49	65	49	48	40	41	25	16	53	43
99.5	18	27	25	14	10	12	53	35	52	44	46	21	32	19	13	42	34
99.8	13	22	17	11	10	9	29	27	43	40	43	18	25	14	10	33	21
99.9	11	20	11	10	10	8	23	24	38	36	41	17	22	11	9	26	19
99.95	9	19	10	9	9	7	20	10	10	20	40	16	20	10	8	18	17
99.99	7	18	10	8	9	5	17	10	10	19	37	14	18	8	6	10	15

Note: Based on daily values. Period of Record 1942 through 2000

SOUTH PLATTE RIVER AT HENDERSON GAGE FLOW DURATION - BASE CONDITIONS (5432.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Flow (cfs) Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	16676	2635	2848	4646	11390	19606	19546	8685	11052	4150	6114	2038	1254	4646	19606	11052	6114
0.05	11159	2635	2848	4646	11390	19606	19546	8685	11052	4150	6114	2038	1254	4010	15493	10148	5203
0.1	9730	1223	2780	4396	10941	15537	12886	7679	10697	3680	5797	1847	1157	3231	12848	8603	2658
0.2	8199	1049	1847	3682	9549	12790	10305	6357	9506	2864	2843	1723	1130	2787	10942	6701	2314
0.5	6343	971	1249	2809	6476	9953	8811	4838	6160	2302	2420	1587	1030	1979	8858	4680	1792
1	5033	863	988	2202	4919	7919	7967	4067	4514	1928	1952	1392	954	1419	7439	3776	1418
2	3797	773	821	1603	3662	6603	6723	3384	3443	1360	1460	1120	861	1064	6108	2950	1068
5	2259	680	687	1051	1916	5163	4758	2518	1924	931	838	860	688	785	4400	1945	770
10	1348	590	594	806	1324	3771	3616	1856	1265	687	606	630	581	657	3104	1365	607
15	976	526	522	687	1049	2871	2955	1533	998	551	504	547	501	567	2346	1083	517
20	773	490	461	593	862	2262	2507	1329	878	498	452	475	437	502	1840	915	455
30	570	398	402	447	585	1377	1852	1014	673	407	379	397	354	415	1240	695	375
40	454	339	349	373	461	907	1427	842	568	355	322	330	315	353	884	564	322
50	373	278	299	311	360	646	1132	708	481	310	276	287	269	297	638	474	277
60	311	239	248	256	287	498	878	612	412	267	246	252	240	247	489	391	246
70	253	191	212	212	225	398	688	517	356	232	210	213	212	206	374	330	212
80	203	131	164	162	167	321	512	422	296	198	166	174	165	152	278	261	169
85	171	108	136	136	137	270	440	377	248	180	144	152	142	127	230	230	146
90	137	89	116	117	107	226	359	320	204	156	122	128	119	105	178	196	123
95	101	70	93	88	70	169	267	254	157	124	93	103	95	80	120	154	97
98	73	51	72	59	32	114	175	201	113	96	76	79	69	58	70	113	76
99	56	44	61	42	21	78	129	165	92	81	71	72	57	47	38	93	66
99.5	41	39	52	25	17	48	104	121	75	70	60	63	48	38	23	77	55
99.8	26	35	48	20	13	27	44	93	47	52	49	53	37	27	15	60	45
99.9	18	32	46	19	11	10	13	58	39	48	46	50	29	20	11	43	39
99.95	13	30	45	18	10	9	10	30	10	45	44	48	10	19	9	34	33
99.99	7	27	42	17	6	8	7	26	7	41	40	44	8	17	6	9	9

Note: Based on daily values. Period of Record 1942 through 2000

SOUTH PLATTE RIVER AT HENDERSON GAGE FLOW DURATION - WITH PROJECT CONDITIONS (5437.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Flow (cfs) Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	14768	2633	2847	4645	11546	19609	14902	8688	11052	4159	6130	2034	1250	4645	19609	11052	6130
0.05	10969	2633	2847	4645	11546	19609	14902	8688	11052	4159	6130	2034	1250	4010	14185	10147	5206
0.1	9401	1223	2779	4384	10340	15530	13087	7678	10697	3685	5808	1842	1157	3231	12781	8602	2664
0.2	8135	1049	1847	3653	8412	12512	9715	6356	9504	2863	2845	1713	1130	2787	10534	6700	2280
0.5	6419	971	1249	2857	6286	9641	8595	4836	6161	2302	2406	1570	1030	1978	8634	4675	1752
1	5092	863	988	2232	4922	8034	7911	4049	4503	1928	1880	1384	948	1389	7478	3749	1413
2	3796	772	809	1570	3582	6745	6791	3356	3401	1342	1462	1105	861	1061	6195	2930	1061
5	2246	677	679	1042	1914	5201	4866	2546	1879	934	834	841	688	780	4443	1938	762
10	1343	582	582	798	1305	3850	3666	1836	1264	665	599	616	576	647	3074	1381	597
15	973	523	498	678	1034	2782	2974	1552	990	551	498	542	500	556	2326	1079	511
20	770	487	444	583	842	2220	2512	1351	874	496	449	466	438	494	1824	918	451
30	565	395	392	444	578	1344	1818	1031	673	405	372	388	353	408	1225	697	369
40	450	336	340	371	454	893	1423	856	571	354	317	323	313	348	875	566	318
50	370	275	294	308	353	639	1125	716	483	308	276	281	266	293	636	473	275
60	308	237	243	253	283	488	878	614	420	265	245	249	238	244	483	393	243
70	251	189	206	209	222	389	689	520	363	232	209	210	210	202	369	331	210
80	201	131	162	160	165	314	513	425	299	199	166	171	168	151	274	262	168
85	170	108	134	134	135	265	436	376	256	180	141	148	147	125	226	232	145
90	136	88	114	114	104	218	360	325	213	157	120	122	122	104	175	199	121
95	100	69	93	86	69	158	270	253	163	128	94	98	96	79	117	157	96
98	72	51	72	58	32	101	181	204	119	103	76	76	68	58	67	117	75
99	56	44	60	40	21	65	129	165	97	86	72	68	59	47	36	98	66
99.5	40	39	52	25	17	40	105	121	73	74	67	57	48	37	22	80	57
99.8	24	34	48	20	13	18	44	87	39	63	62	45	37	27	15	64	45
99.9	17	32	47	19	11	10	13	69	13	48	60	34	29	20	11	36	37
99.95	12	30	45	18	10	9	10	30	10	45	58	30	10	19	9	19	29
99.99	7	27	43	17	6	8	6	26	7	41	56	30	8	17	6	9	9

Note: Based on daily values. Period of Record 1942 through 2000

SOUTH PLATTE RIVER AT HENDERSON GAGE FLOW DURATION - WITH PROJECT CONDITIONS (5444.0 FT MSL POOL)

Percent of Time Equalled or Exceeded	Flow (cfs) Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
0.01	14768	2629	2845	4644	11546	19626	14823	8695	11053	4174	6139	2026	1243	4644	19626	11053	6139
0.05	10855	2629	2845	4644	11546	19626	14823	8695	11053	4174	6139	2026	1243	4009	14185	9509	5208
0.1	9264	1223	2778	4395	10340	15538	13075	7685	10186	3693	5815	1844	1157	3231	12781	8318	2623
0.2	8010	1049	1847	3682	8422	12810	9716	6223	8799	2863	2823	1715	1130	2789	10544	6565	2203
0.5	6297	971	1249	2811	6224	9590	8602	4682	5661	2306	2311	1570	1031	1939	8555	4401	1720
1	4990	864	988	2163	4799	7679	7919	3956	4109	1914	1836	1384	942	1390	7336	3599	1398
2	3719	768	810	1566	3454	6508	6761	3323	3171	1295	1415	1097	847	1051	6080	2874	1049
5	2220	678	679	1035	1897	5144	4775	2527	1852	915	771	818	682	774	4373	1920	734
10	1328	576	582	790	1275	3702	3576	1853	1263	654	589	613	562	645	3020	1373	590
15	960	520	495	673	1014	2771	2899	1559	988	551	491	534	497	550	2297	1080	505
20	762	477	440	570	807	2192	2463	1355	868	494	443	464	433	486	1804	918	446
30	562	392	384	435	556	1319	1827	1037	681	406	369	379	349	399	1201	705	363
40	445	332	336	360	428	877	1398	856	573	358	315	321	311	342	858	571	316
50	366	274	287	295	334	629	1101	725	491	311	274	280	262	287	628	476	273
60	305	235	237	244	267	479	867	622	424	270	245	248	235	239	473	397	242
70	249	185	202	206	209	382	700	528	369	236	210	211	209	199	361	335	210
80	201	131	160	156	158	305	518	434	311	204	168	169	166	149	266	270	168
85	170	107	133	130	130	263	443	380	274	186	144	145	144	123	217	239	144
90	135	88	111	107	96	212	364	322	235	163	121	121	122	101	168	209	121
95	99	69	93	79	63	152	272	251	186	135	95	97	94	78	113	165	95
98	70	51	71	54	30	91	183	204	135	110	74	74	69	56	61	125	73
99	52	44	60	36	20	58	127	158	108	99	63	63	59	46	32	107	61
99.5	38	39	52	23	16	27	112	121	74	87	50	54	47	37	22	88	50
99.8	23	35	48	19	12	13	65	89	40	66	49	43	37	25	14	63	41
99.9	16	32	47	19	10	9	30	68	10	49	48	33	29	20	10	39	35
99.95	11	30	45	18	8	9	28	30	8	47	48	30	10	19	8	17	29
99.99	7	27	43	17	5	7	26	26	5	42	47	30	8	17	5	7	9

Note: Based on daily values. Period of Record 1942 through 2000